# The Journal

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AMERICAN ASSOCIATION OF NURSE ANESTHETISTS

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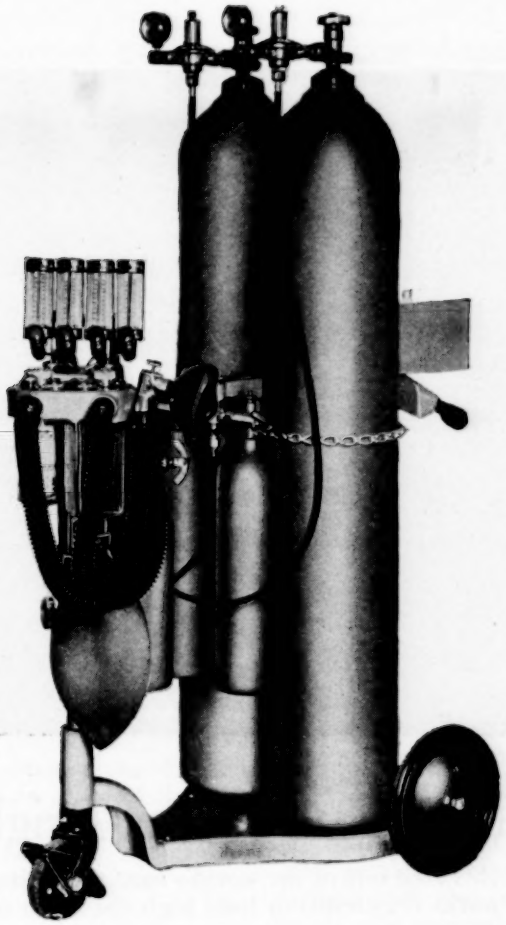

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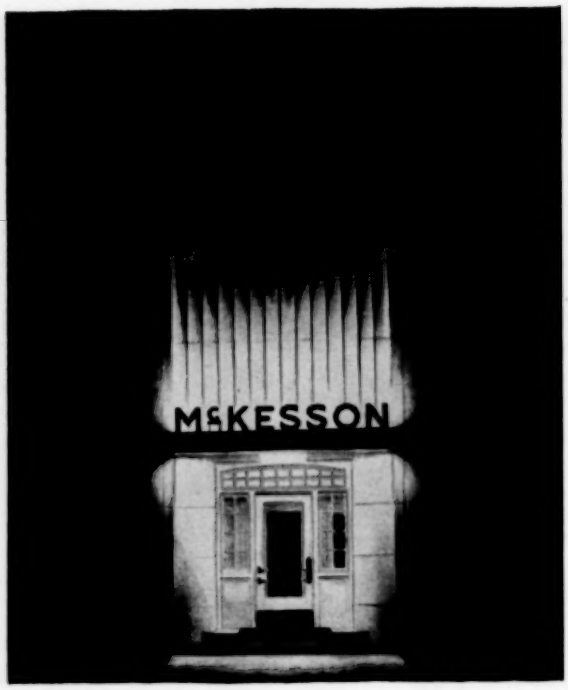


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The Journal of the American Association of Nurse Anesthetists

VOLUME XVII FEBRUARY, 1949 NUMBER ONE

# THE VALUE AND METHOD OF ADMINISTERING TESTS

Elizabeth L. Kemble, R.N., Ed.D.*
New York City

It is a rather familiar experience for me to talk with nurses who are interested in the value and method of administering tests. This is my first experience, however, in discussing this subject with a highly specialized group of nurses who have a major interest in the field of anesthesiology. I consider it a privilege to be here this morning.

Any comments that I make in relation to this problem of evaluation must be themselves evaluated on the basis of my orientation to evaluation in nursing. Nevertheless, we can recognize that the basic principles and technics of evaluation for selection or for achievement and adjustment are the same for medicine, law, teaching, nursing, or some special branch of work such as the practice of anesthesia.

In general, one might say that there are two basic questions to be answered before tests or devices are chosen for selecting applicants for admission to a school, and before technics are decided upon for evaluating the progress of the student admitted to the school. First, what are the tasks which she will be called upon to perform? Second, what are the personal adjustments which she will be expected to make?

Let us consider these questions in relation to the selection of applicants to some 57 schools of anesthesiology. What tasks will the student be called upon to perform? What personal adjustments will she be expected to make? An oversimplification of the answers might be to state that she must acquire the knowledge, skills, applications, and appreciations to administer a wide variety of anesthetics, to patients of all ages, suffering from a variety of ills and ailments. She must also establish good personal relations with the patient, the surgeon, the operating room staff, the nursing personnel on the ward, the housekeeping group and the auxiliary workers, the administrative staff of the hospital, and representative members of the community. And what does the community expect from nurse anesthetists? The community expects safe, competent, considerate practice of anesthesiology.

What then do we need to know about the applicant in order to have a reasonable degree of assurance that she will be able to perform the required tasks and make the necessary adjustments in a school of anesthesiology.

There are several ways of approaching the problem of selec-

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*National League of Nursing Education.

tion of applicants for schools of anesthesiology. One way is to consider first the persistent needs of society which anesthetists can meet in a unique way. You and I, as members of a community, expect a high degree of competence in an anesthetist. We also expect that she will be a well adjusted person who is interested in our well-being and one who gets along with her fellow workers.

Schools of anesthesiology design a curriculum in order to provide learning experience which will enable their graduates to practice with a high degree of competence as well adjusted women doing work that brings a large measure of personal satisfaction. Aims and objectives are clearly stated and provide, insofar as the school situation can do so, opportunities for the fullest possible development of each student, to the end that society's needs will be met, and each student is given opportunities to develop to the fullest of her potentialities.

Faculties of schools of anesthesiology must select from among those seeking admission only those applicants who seem to have the qualifications essential for carrying the school program and ultimately serving society as nurse anesthetists. If the learning experiences in the school of anesthesiology have been carefully planned on the basis of society's needs, then it logically follows that applicants should be chosen who have a reasonable chance of success in carrying the academic program and who possess the personal qualifications essential in an anesthetist.

There are many anesthetists about whom it can be said, "She is a fine anesthetist." How can we choose young women for admission to schools of anesthesiology about whom the same thing can be said when they graduate? There are many contributing factors that enter into the expression, "She is a fine anesthetist."

First, we can consider *intelligence*. It seems reasonable to assume that anesthetists must have a high degree of intelligence. The level and kinds of intelligence, however, must be determined by careful study.

Second, the *achievement* of the prospective student should be made known to us, both her achievement when she presents herself for admission to the school and past achievement in a school of nursing or college.

Third, we must learn something of her *personality and adjustment*, interests and attitudes, if we are to expect this young woman to inspire confidence (and who needs to do so more than an anesthetist?), if we expect her to be well adjusted under the most trying circumstances, and if we count on her to maintain good person-to-person relationships.

Fourth, we must learn about her *environmental history* if we are to understand her as a person and gain some clues related to her ability to fit into the school environment. And last but not least, if she is to practice anesthesiology, we must know that her *health* is equal to the task.

## Before Admission to the School

The evaluative tools and technics which can be used in the selection process can be placed in four major categories:

1. *Written forms* such as application blanks, transcripts of academic records, and letters of reference.
2. *Interviews* with more than one member of the faculty, if possible.
3. *Pre-entrance battery of tests,* which include a good standardized intelligence test and certain achievement tests, both written and performance, suitable for this specialized program.
4. *Physical examination* with special attention to visual and auditory acuity, tactile sensitivity, and motor speed and co-ordination. Speech and voice tests would undoubtedly prove of value as well.

Only by careful study and analysis can you come to certain decisions related to the levels and kinds of intelligence required for admission to your schools. Only by careful study and analysis can you demonstrate that a high degree of achievement in certain areas—let us say in a nursing school—is related positively with a high degree of achievement in certain areas in the school of anesthesiology. But this can be done, eventually, with a reasonable degree of success.

Perhaps, at first, each school will validate its own selection process. Later there may be agreement among all the schools that certain qualifications must be met, in intelligence and achievement, for example, before students are admitted.

It might be argued that graduation from an accredited school of nursing and registration by a state guarantee the level and kinds of intelligence essential to the practice of anesthesiology. We cannot make this assumption. Just as we recognize that some nurses perform satisfactorily and are happy doing private duty, others do their best work and find their greatest satisfactions in operating room work. It would seem desirable to test the intelligence of applicants seeking admission to schools of anesthesiology. According to Thurstone, there are certain primary mental abilities: verbal meaning, word fluency, reasoning, number, and space. His test of intelligence gives scores in these primary mental abilities. Does an anesthetist need a high degree of mental ability in verbal meaning, in any or a combination or possibly all of these primary mental abilities? The American Council on Education's psychologic test is designed to give two scores—one linguistic and the other quantitative. Does an anesthetist need to think both verbally and quantitatively?

Time today does not permit a lengthy discussion of the various intelligence tests now available for which satisfactory validity and reliability have been established. Nor is it possible to discuss tests suitable for individual or group administration. It is important to stress the use of a good standardized intelligence test as one of the tools to be used in the selection process.

Having given consideration to the intelligence of the applicant, we now wish to know as much as possible about her past achievement. Certain records are available to us from the school of nursing. These records should be considered from the standpoint of their advantages and limitations.

Present academic achievement can be measured by standardized achievement tests in the areas essential to learning in a school of anesthesiology. Most pre-entrance test batteries include tests in reading — comprehension and level—, tests in arithmetic, and tests in the social and natural

sciences. Scores on these tests can be compared with norms groups made up of applicants to schools of anesthesiology and, if desired, with students entering liberal arts colleges. In the final consideration, the admission committee considers the critical scores for its own school. Some schools admit only those students whose scores on the intelligence and achievement tests in the preentrance battery are well above the mean for the norms group.

The intelligence and achievement of potential students can be measured with a fair degree of satisfaction. Appraisal of personality and adjustment is not so easily accomplished. There are numerous tests of personality and social adjustment available today. Most of them are of the questionnaire type with their origin in the contribution of Dr. Woodworth more than twenty years ago. Research seems to indicate that they are of little or no value in prediction, although of some possible value in guidance. Projective technics seem more suitable for gaining understanding of the underlying dynamics of personality. By their very nature, however, they are difficult to score and interpret. For the most part their most satisfactory use has been in individual administration for clinical purposes.

Some clues about adjustment and personality can be secured from the statements of others who have had contact with the applicant. It is possible to gain from teachers, and others, statements relative to the impression the applicant made on them.

Much can be gained through a skilfully conducted interview. The information sheet or application form filled out by the potential student can give us information about the activities in which she participated in the school of nursing or college and in community projects. Letters of reference from pastors or ministers can give us additional help in gaining a better understanding of the individual. Letters of reference have their limitations, too, but we can use them while recognizing that they probably give us a somewhat exaggerated picture of the good points and all too frequently make no mention of the weaknesses or liabilities. But few among us would ask for a reference from someone who would emphasize our bad points. From this variety of sources we can gain a little insight into the kind of person "knocking at the door" of the school of anesthesiology. From some of these sources we can gain information about the attitudes and interests of the individual. This is particularly true of the devices of interview and evidence of past participation in school and community activities.

Attitudes and interests are learned, and we can obtain some clues to the possible attitudes and interests of our students by knowing something about the learning experiences of the individual. This brings us to a consideration of the history and environmental background of the student. Age, number of siblings, occupation of mother and father, and size of town in which she has lived most of her life are among the many items which would be listed and filled out by the student.

The history will also give us some information about the

health history, kinds and times of illness, and so forth. But evaluation of the health of the applicant can be done more satisfactorily by means of a complete and thorough physical examination. It is important that we give the health of the prospective student due consideration.

In our appraisal, then, we have considered such aspects as the intelligence, achievement, personality and adjustment, attitudes—and we might add interests—, history and environmental background, and health. A wide variety of tools are available for appraising these aspects; they represent widely varying degrees of reliability. Emphasis should be given here to the understanding of the total person, not to any one phase or aspect of her. The point, of course, is that we consider the configuration, the relation of intelligence scores to achievement scores and their adjustment to attitudes, to environment, and to health. Recognition is given to the importance of all these things for each individual, but cognizance is also given to the fact that the configuration is different for each individual in terms of *her* heredity, environment, and maturation.

The comprehensive and dynamic qualities of evaluation again become apparent in our appraisal of the individual. We evaluate her on the basis of a wide variety of considerations using the best possible tools available. We consider what entered into *her* growth and development, what her present potentialities seem to be, and where these potentialities and her interests seem apt to direct her.

The on-going and comprehensive nature of evaluation in relation to each individual in terms of our educational objectives requires that we give emphasis to evaluation as a process. Evaluation of the student is not finished with the decision regarding her fitness for entering upon a program of study in the school of anesthesiology. Her achievement and adjustment must be continually evaluated as she progresses through the school. Evaluation of the individual student, or groups of students, as well as evaluation of the educational program, leads us to make needed modifications and changes in our plans of instruction, administration, and guidance.

In the problem of selection of students for admission to schools of anesthesiology, we have endeavored to progress from the persistent needs of society which anesthetists meet through the curriculum designed to bring about changes in students which will meet the needs of the community—to the process of selecting the right students for enrolment in your schools. It is important to emphasize here what must be apparent when the selection process is considered. Decision relating to admission or rejection of the student should be made on the basis of all available reliable information, not on the basis of one technic alone.

It is safe to say, except in rare instances, that it would be unfair to reject a student on the basis of one interview, or on the basis of the intelligence test scores alone, or on her record of past achievement. But when we assemble and evaluate the test results, transcript of academic records, per-

sonal history, and reports of interviews and physical examination, we begin to see a person emerge from all this evidence uniquely different from all the others under consideration. We see the person a little more nearly as a whole and have some basis on which to make a decision regarding her potentialities and desirability as a student.

Let us assume that you have decided to use a variety of tools and technics as aids in the selection of students for enrolment in your schools. Each device should be selected because it can most effectively obtain the information you desire. For example, it is probably important to get some evidence of the intelligence of the candidate. Such evidence can most efficiently be obtained from a good standardized intelligence test. Therefore, it is uneconomical and inefficient to attempt to appraise intelligence from letters of reference or personal interview. Likewise, evidence of academic achievement can best be secured from reliable records of past and present academic achievement on performance and written standardized achievement tests.

Letters of reference, personal history, and interviews help us to understand a little about the complex person seeking admission to the school. Too much importance cannot be placed on the personal interview. In this face-to-face situation the interviewer can observe the potential student. Attractiveness of appearance, pleasant voice, good speech, poise, alertness of manner, graciousness of behavior, and similar characteristics so important to anesthetists come under favorable scrutiny. These characteristics are not manifested on a paper-and-pencil test.

Interviews give clues also to interests and attitudes that are so important if an anesthetist is to be a fine anesthetist.

Before admitting an applicant to a school, it is important to learn as much as possible about the student's intelligence, achievement, personality and adjustment, environmental history, and health. Four major categories of tools and technics can help us obtain this information, viz, written forms, interviews, pre-entrance battery of tests, and physical examination.

### Tools and Technics Useful in Evaluation after Admission to the School

1. *Test of achievement*—written, oral, and performance.
2. *Observational recordings*—rating devices, anecdotal.
3. *Interviews*—group and individual conferences.

Evaluation of the student while in the school is a continuous process after a careful selection of applicants has been made. The matter of evaluation is not finished with careful selection. Evaluation is an on-going dynamic process. Briefly, there are two major phases or aspects of evaluation of the student as she progresses in her school work. These two major phases or aspects are achievement and adjustment. As Sister Helen Marie Hughes wrote in the November issue of the *JOURNAL*, "Measurement plays an important part in the practice of anesthesia, whether it be measurement of dosage of anesthetic gases or the measurement and evaluation of the stu-

dents trained in the school of anesthesiology." Implicit in Sister's comment is the understanding of the concept of evaluation, because Sister mentions both measurement and evaluation. Evaluation is broader in scope and more dynamic in nature than measurement, although, of course, tools which measure are used among other devices in the process of evaluation. In the final analysis we try to put a value on the person as an anesthetist on the basis or her achievement and adjustment.

Consider for a moment the matter of achievement. At certain articulation points along the way in the school of anesthesiology, various technics can be used to appraise the achievement of the student. Such appraisal is made with consideration of the student's present achievement in relation to her past achievement and potentialities. For example, if a student had a previous record of high scholastic achievement in physiology but ranked low on a subsequent achievement test in physiology, it would be well to consider all possible reasons for the lower achievement. It would be well also to consider her achievement in relation to her academic potentiality as measured by the intelligence test given before admission.

In addition to the comparison which can be made of present and past achievement and scholastic potentiality, comparisons can be made with her achievement in the test in relation to the achievement of others in her class. Is the score at the average for the class, or is it above, or below? If above or below the average, how far above or below? Further comparisons are possible if standardized tests are developed which are suitable for use in all your schools. Norms can be built which are representative of the population of the students in schools of anesthesiology. This procedure presupposes a similarity of objectives in the schools and a similarity of content in the curriculum or learning experiences.

Work-sample tests, in addition to written tests, can be used for appraising achievement. A work-sample test is a performance test. According to Adkins,[1] "The performance test of achievement or proficiency is called a 'work-sample test' when it requires the applicant to demonstrate his acquired skill by doing an actual segment of work, using tools, materials, and methods characteristic of the job for which the test is designed." Adkins cites a driving test for licensing automobile drivers as an example of a work-sample test. Work-sample tests for anesthetists, for example, could be designed which represent the important elements of giving gas anesthesia.

Various rating devices can be used to estimate the achievement of a worker in a given field. Such observational technics are useful tools provided they are designed, administered, and the results interpreted with careful regard for the rules governing such devices.

Anecdotal records can be used to record the observations of students as they progress through the school. While the element of subjectivity undoubtedly enters

1. Adkins, Dorothy C.: *Construction and Analysis of Achievement Tests* (Washington, D.C.: U.S. Civil Service Commission, 1947).

into the recordings, this can be kept to a minimum with proper understanding of their use. Furthermore, as in the case of rating devices, the consideration of the recordings of anecdotes by several persons over a period of time can present a more reliable picture of the achievement of the student than the anecdotal record of one instructor or one rater. According to Traxler,[2] there are three types of anecdotal records. A clear understanding of which type is to be used can obviate a lot of the difficulties in using anecdotal records satisfactorily.

The adjustment of the student, as was mentioned previously, is of major concern as she progresses through the school. While we can say that achievement and adjustment are the two areas of concern in evaluating the student. we recognize also that these two phases do not represent a clear-cut dichotomy. One is dependent upon and in turn influences the other. If a student in a school of anesthesiology is unhappy in her person-to-person relationships, it is quite possible that this will affect her achievement in the school. Conversely, difficulty in successfully carrying the course work is apt to affect her adjustment adversely.

What are the criteria for judging good adjustment? How can we arrive at an opinion that Miss Jones, a student in School A, is a well adjusted person? Some psychologists consider the well adjusted person to be a "mature personality." Allport[3] described three differentiating characteristics to distinguish the mature personality from one that is still "unripe."

First the mature personality is absorbed in causes and goals that outshine self seeking and vanity, in the ability to lose oneself in work for others. Second, the mature person is able to see himself objectively—has insight, a sense of humor. Third, the mature person has acquired a unifying philosophy of life.

The year or more which students spend in a school of anesthesiology provides repeated opportunities to observe them and to come to some conclusions about maturity or immaturity of personality. Granting that every effort was made to select students who seemed suited to the work by virtue of intelligence, achievement, past history, interests, as well as satisfactory health, it is still the responsibility of directors and faculties of schools of anesthesiology to observe these students closely during the time they are under their supervision. Students, even when selected on the basis of high standards, will differ considerably in poise, diplomacy, voice, confidence of manner, and other qualifications so essential in the nurse anesthetist. They need your help in acquiring, if possible, a satisfactory degree of the qualities you demand of your students.

Interviews, anecdotal records, group conferences, ratings, and even tests impress on the students that you are interested in their achievement and adjustment and help to give the students a feeling of recognition which they need.

*(Continued on page 74)*

2. Traxler, A. E.: *Technics of Guidance* (New York: Harper and Brothers, 1945).

3. Allport, Gordon W.: *Personality: Psychological Interpretation* (New York: Henry Holt & Co.).

# BASIC PSYCHOLOGY OF THE TEACHING PROCESS

George W. Hartmann, Ph.D.*
New York City

The psychology of the teaching process is an old and honorable part of the broad field of educational psychology. It is often pardonably confused with the general learning process with which it obviously stands in peculiarly intimate association; but even the closest of functional connections does not warrant the identification of two distinct forms of human behavior. As a personal and professional enterprise, teaching involves aiding deliberately the learning activities of others than oneself. This special social relation gives rise to the characteristic over-all problems of the formal instructional situation, some of which we shall seek to outline on this occasion.

In my judgment, there are *six* main areas to be distinguished in this broad domain: (1) the comparative efficiency of the various methods of instruction, (2) the interpersonal relations in the teacher-pupil dyad, pupil-pupil patterns, etc., (3) the direct and indirect effects of teaching upon the lives and personalities of teachers themselves, (4) the adaptation of special pedagogic means to definite socioeducational goals, (5) the group dynamics of different types of classroom "societies," and (6) the inner and outer conditions favorable to superior teaching. This list of a half-dozen fields is neither exhaustive nor non-overlapping, but it will nonetheless help to outline our task in preliminary fashion and thereby facilitate the absorption of the chief ideas to be presented.

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*Teachers College, Columbia University.

## METHODS OF INSTRUCTION

So far as (1) is concerned, it must be noted that the bulky statistical and experimental literature reported in such periodicals as the *Journal of Educational Psychology* and the *Journal of Educational Research* makes overwhelming use of the "parallel-group" method for getting at the facts concerning the relative excellence of any two procedures. This basic method involves a matching or initial equating of two groups of learners; one is then exposed to a "treatment" program presumably containing some new factor(s) to be studied and appraised, and the other is a "control" allegedly taught in the usual or traditional way. Re-tests at the end must reveal a *differential* gain (i.e., gains in excess of what time alone produces) in some significant area of pupil performance, or there is no basis for evaluating either of the methods as better, worse, or even equal to the other.

The logic behind this conventional approach must be understood before the frequently disconcerting findings can be assimilated. The merit of any teaching activity is not found in any characteristics it possesses as such, but in its connection with *significant pupil changes.* This

is the controlling criterion for judging the process of instruction. Presumably, *education is an effort to improve the human being* in some respect. We assume that, as an immediate result of sound teaching, *the pupil is not only different but also better* than would otherwise be the case. Years ago I accordingly defined teaching efficiency in terms of the following formula of essential components, viz, as the *production of the largest number of qualitatively desirable alterations in the organism in the least amount of time with the least "cost" and with the maximum amount of satisfaction to all concerned.* Even this omnibus collection of aspects is probably incomplete and suggests why the search for the One Best Technic of teaching may be a will-o'-the-wisp in the eyes of some of the keenest critics of this development. The evidence indicates that there are many good methods to choose from and to use on various suitable occasions rather than a *single* one to be preferred at all times and in all places.

This pluralistic and relativistic conclusion declares essentially that a lecture, for example, is neither absolutely superior nor generally inferior to a small group discussion as a teaching device, but that its merit is a function of such variables as (a) who uses it, (b) the audience, (c) the topic, (d) the aim, and (e) other contextual factors such as familiarity, expectation, and related elements. Consequently, one dare not say on the basis of existing data that one should adopt or eschew certain commonly recognized teaching patterns; the *quality* factor is frequently crucial in the sense that a good example of "traditional" practices is more to be esteemed in terms of the human outcome than a poor instance of the "progressive" approach.

It would be comforting if we could say that our investigations in psychology or education typically produce results as dependable as those that Pasteur obtained in his famous demonstration of the worth of his anthrax serum. This ideal is occasionally approximated, but more often it stands as a model to arouse our professional envy. You recall what this involved: A crowd of country yokels gathered at a French agricultural fair in which two pens of sheep were displayed. The animals were litter-mates and therefore biologically "equivalent" for the purpose prominent here. One group was inoculated with the protective agent; the other was not. An infected animal was then allowed to wander among both groups. Then, day by day, the amazed spectators saw every single one of the untreated sheep die of the disease, while not a single one of the others perished. This astounding 100 per cent versus 0 per cent relation is the standard at which all "control" group studies aim, for it supplies the most convincing combination of arithmetical and ocular proof. In the area of professional experience here being considered, we are usually compelled to accept relations of the 70-30, 60-40, or even 51-49 type, where only slight margins of probability favor one or the other procedure. However, we should not underestimate even this less persuasive form of evidence, for the accumulated effect of such analyses can be great in reorganizing our behavior, particularly if the results tend to be consistently in the same direction.

At the risk of oversimplifying a generation of arduous research labors, it seems reasonable to sum-

marize them by the proposition that the *newer experimentally-motivated teaching patterns have usually produced better results than older more stereotyped procedures.* This fact as such is undeniable; the reason, however, may be nothing inherent in these methods but the appeal of anything new to the learners plus the corresponding greater zeal and enthusiasm displayed by instructors embarked in such adventures in pedagogy. One conclusion, fortunately, is incontestable: *Whatever encourages student initiative and responsibility does produce superior products.* This insight alone marks a priceless advance in standard teaching practice.

### INTERPERSONAL RELATIONS

Moving now to (2), we find that the nature of the personal or emotional response in the individualized teacher-pupil pairings is as important as the purely cognitive interchange supposed to be primary. Psychology today is convinced that man is as much—or more—an irrational (better non-rational) creature as he is a severely rational one. Concretely, this means that subtle affective factors, e.g., mutual likes and dislikes, make a big difference in the impact of teachers on pupils and vice versa. As organisms, we are so constituted that our (a) thinking, (b) feeling, and (c) doing are not strictly separate operations of the mind; in any actual situation, all three phases are simultaneously present even though in various degrees. How pupils react emotionally to the stimuli presented by the teacher is often the decisive factor in their performance. If, for example, a professor of law seems to be more concerned with what the layman calls "technicalities" than with an earnest search for justice, certain idealistic students are repelled by this emphasis in a way which hampers their appreciation and mastery of useful procedural details. Such a reaction rests on the fact that man appears to be a Feeler before he is a Thinker or Doer. Teachers neglect this elementary truism at their peril.

Since teaching, for better or worse, always occurs in a rich context of buried or implicit "suggestions" emanating from the *total* situation, the related phenomenon of *rapport* deserves brief mention. Rapport here refers to the character of the interplay between the members of any group, notably a group as small as two individuals. It means a satisfying closeness of personal interstimulation. We are usually in good or high rapport (= warmth) with someone we know well, whose company we enjoy, and whom we trust; poor or low rapport, on the other hand, means "coolness," distance, and uncertainty about the other's response. Obviously, the former situation makes for better instruction because of the background of favorable motivation in the way of friendly receptivity which it fosters, whereas the latter acts as a positive barrier to the *reciprocal flow* of influences which constitute genuine education. Years ago it was noted that Negro school children emerged with slightly higher IQ scores when tested by Negro psychometrists than when white personnel took charge. Presumably such desiderata as confidence, encouragement, and the will to excel were all more operative in a social setting free from the hurtful influence of stereotyped antagonisms than in one where presumably some embarrassed or restrained hostility dampened the performance — on both sides!

The chief recommendation which emerges from this analysis is that the teaching function requires a broad range of sensitivity to values which may not be one's own, but which must be understood and given free scope if the learner's growth is to be promoted. In other words, a teacher must accept as a governing value the principle that his students' private values are instrumental goods by means of which they can ultimately become responsive to excellences in nature hitherto unrecognized and unappreciated. This benevolent hospitality to all modes of individuality is probably a central element in constructive teacher-pupil relations and is therefore a generalized attitude that instructors must develop if they are to discharge their other tasks successfully.

### Teaching and the Teacher

From the strictly vocational angle, few technical problems are more fascinating than the exact determination of just what happens to one's personality as a result of following career X rather than career Y. This is aspect (3) of my presentation. Indeed, one of the commoner "popular" reasons for urging youth *not* to adopt teaching as a means of livelihood has been the claim that the individual is thereby transformed into a somewhat less desirable human being with distinctly more objectionable qualities than would otherwise be the case. Actually, what little evidence we have on this important point is just to the contrary. In a recent study I asked 110 experienced teachers with widely diversified backgrounds to compare themselves now and when they started teaching with respect to twenty-six common behavior traits. In every single item this group reported an overwhelming and consistent majority of good or favorable "character" changes. Thus, 76.5 per cent felt they had become *less* "bitter, nervous, or anxious"; 62.7 per cent declared they had grown *more* "cheerful or optimistic"; 58.2 per cent believed they now exhibited more originality and creativeness. These are random selections from the longer list of attributes and show pretty plainly that, at least in their own opinion, teachers do not deteriorate as human beings as a result of their lives as classroom managers.

This reveals a long-hidden value which may be an advantage inherent in the teaching process as contrasted with other job activities, viz, that the very business of engaging in instruction (at any level and of any type) apparently normally weakens the practitioner's unpleasant characteristics and strengthens agreeable ones. The precise machinery responsible for this gratifying result is not too well understood and in any event need not concern us here. What is important is the recognition that the miscellanous acts of teaching, when sustained and bettered over the years, create positive assets in the way of originally unanticipated personality gains. Evidently while one is engaged in the work of improving others in some respect, one is simultaneously improving oneself. If this is not an overlooked reward for doing good, what is?

### Socioeducational Goals

Subdivision (4) of the psychology of teaching pertains to the problem of developing and testing common devices for reaching certain social and educational objectives. Suppose we say that one of the aims

of a certain course is the promotion of democratic conduct (presumably all "courses" in our society accept this as a tacit goal!). The issue then arises: Is this aim being realized under existing circumstances? A similar query appears in other situations, such as when one claims that the chief purpose of the "exercises" is to foster clear thinking, technical skill in handling apparatus, clinical judgment, or any other worthy purpose.

Long ago the critical psychologist noted that it was one thing to establish or state a goal and quite another to arrange steps that would bring it about. Thus, if democratic behavior involves, among other things, conscientious regard for even the smallest and least popular minority, then merely loudly affirming that every American, by virtue of being an American, is naturally one who always responds democratically to a social challenge is not enough. The insights and appreciations that lead to acts of protection and respect for even the humblest individual must be fostered and developed by appropriately related performances. Similarly, whatever specific aims a teacher may have can only be reached by way of experiences that in some manner already embody part of the goal. Pupils do not become independent thinkers if they are held rigidly to a system of learning that stresses primarily the reproduction of either the instructor's best ideas or the most solid facts in print, for knowing even these good details supplies no more than the raw materials of genuine thought. A common pedagogic error occurs right at this point, viz, assuming that a larger primary goal has been achieved when all that has happened is that some minor intermediate barrier has been hurdled. Perhaps if universal principles of organization were really more ardently cherished, they would be more readily attained than the commoner substitute-satisfactions of learning "pin-point" but frequently unrelated specifics. However, this is not to urge a worship of Wholes and a pseudopedantic contempt for Parts; a sounder solution seems to be some more closely fused Part-Whole unity such as is illustrated by the design and operation of any living organism.

### GROUP DYNAMICS

Under category (5) come all those problems that show that a schoolroom is as much a concern of social psychology as of educational psychology in the older individualistic sense. As long as instruction involves groups larger than a tutorial pair, we may be sure that there will be such phenomena as emotional atmosphere, class morale, the presence of an autocratic or laissez-faire or co-operative spirit, sociometric constellations, and other indications that a class of learners is a miniature society governed by the general and special laws applicable to such aggregations. Observant teachers have long been aware there is such a thing as the "mood" of a class, which, if receptive to the teacher's efforts, makes for progress in pedagogic affairs, but, if antagonistic, blocks most attempts to make serious headway in any field. If the basic feeling-tone is "positive," learning occurs with a minimum of friction. The effective teacher therefore finds it advantageous to insure, by managing the "stage-setting" in one way or another, that this pervasive sense of gregarious pleasantness emerges and persists as an indispensable background condition for facili-

tating the main "intake and output" activities that constitute the core of his responsibility.

The crowd psychology of the schoolroom reveals itself in such reactions as the widespread nervous mannerisms observed in elementary classes taught by tense teachers and the calmer patterns found with more relaxed teachers; the differential responses (coolness versus warmth?) of students arranged in one seating pattern, or "architectural" structuring, as compared to another; the emergence of group solidarity through the unifying consequences of doing something in common, such as voting on a suggestion or even laughing at the same joke; and many allied forms of collective behavior. The teaching process often moves smoothly or lumberingly to the degree that these "mass" performances can be stimulated and controlled along intended lines by the specialist in charge.

## Conditions Favoring Superior Teaching

Within area (6) belong all these "inner and outer conditions" of instruction that possess some demonstrable favorable influence upon the course of teaching. Thus, the attitude of the community toward education in general or toward a specific school and program plays either a supporting or depressing part in shaping the minutest motivation of those directly affected by the teaching situation. It is probably very hard for either staff or students in a chiropractic training school to rise to the heights of inspired work in the face of severe medical opposition, legislative discrimination, and a semiscornful public opinion, unless something akin to profound intellectual conviction and evangelical zeal combine to overcome these obstacles. Similarly if the view prevails that no one would teach who could possibly do anything more distinguished—and if those who taught more than half agreed with this unflattering opinion—then it is obvious that a crippling inhibition has been placed upon the exercise of the teaching function in such a culture. Professional pride in any field must be fed by some deep sense of the importance of what one is doing before it is possible to approach supreme excellence in its discharge.

## Imperatives for Teacher Emphasis

This rapid descriptive prologue to what I consider the six main sections of the teaching process would be even more incomplete than it must necessarily be if I closed without some applications which may be honestly recommended for *all* instructional situations. These are conveniently grouped as imperatives for teacher emphasis in the following modification and extension of Mursell's formal schema:

1. *Context is all-important.* Since all experience is that of some "figure" on some "ground," never disregard the nature of the entire psychophysical field setting within which you and the students are jointly operating.

2. *Focalize or "point" your lesson development.* All natural events may rightly begin vaguely or relatively unstructured, but they should always culminate in some sharp, clear, vivid, definite, specific impression.

3. *Individualize meanings and values.* There is always something purely personal, private, and unique about psychologic realities; the best

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# FURTHER OBSERVATIONS ON ANESTHESIA FOR THE SURGICAL TREATMENT OF CYANOTIC CONGENITAL HEART DISEASE

Olive L. Berger, R.N.*
Baltimore

The presentation by Dr. Blalock has made clear the anatomic and physiologic abnormalities which occur in this group of patients, and the moving picture has traced the steps of the operative procedure. Such a background provides a good introduction to the problems which these cases present to the anesthetist.

In a recent report in the *JOURNAL* these problems were discussed at some length. Attention was directed chiefly to the so-called typical case of tetralogy of Fallot, with emphasis on such points as premedication, conduct of anesthesia, complications, and their management. In the light of further experience we shall review these points briefly today, with a discussion of management in some unusual cases of congenital cyanotic heart disease.

## PREMEDICATION

Many of these patients present a severe psychologic problem as they have been spoiled and pampered all of their lives. Since crying increases cyanosis and may even lead to unconsciousness as a result of cerebral anoxia, it is more than usually important to maintain good rapport with the patient. A preliminary visit by the anesthetist is well repaid by the smooth induction which may be achieved in a cooperative, placid child. The child is not allowed to see his parents on the day of operation. This policy minimizes emotional disturbances and contributes to smoother, safer anesthesia. Adequate doses of premedication may be given without fear, since these patients not only tolerate morphine well, but the drug seems to have a specific effect in relieving the more severe attacks of cyanosis which occur frequently in some individuals. We believe that a dose slightly in excess of the accepted formula, i.e., 1 mg. for each ten pounds of body weight, is particularly desirable for those patients known to have a very low pulmonary blood flow. The respiratory depression is offset by the lower metabolic rate and the facility with which the anesthetist may take control of the respirations.

Atropine in a ratio of 1:20 with morphine is still used most commonly, but scopolamine has been employed recently in adolescent and adult patients with gratifying results. Its hypnotic and amnesic properties are of considerable value in these apprehensive individuals.

## CONDUCT OF ANESTHESIA

The conduct of anesthesia remains essentially as previously described. Induction has been by the

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*Chief Anesthetist, The Johns Hopkins Hospital.

semi-closed method. Cyclopropane, with minimal amounts of added ether, by the intratracheal to-and-fro absorption technic, is employed for maintenance. Lower first plane or upper second plane anesthesia still provides the most satisfactory results.

While cyclopropane undoubtedly predisposes to cardiac arrhythmia, this is usually transient and can be controlled by modifying the anesthetic and oxygen tensions or altering the anesthesia level. Results with more than 800 anesthesias for cardiac surgery have made us feel justified in continuing the use of cyclopropane even though other anesthetic gases and combinations of agents do afford satisfactory anesthesia. The selection of agents must depend on the desires and requirements of the surgeon as well as the needs of the individual patient.

Some surgeons prefer to employ the cautery to shorten the operative time. This practice necessitates the use of nonexplosive agents, and good results have been obtained with nitrous oxide-oxygen and curare. We have had no experience with such a combination in this series.

We have not used the "respirator" type of mechanism to control respirations, since we believe that the simple assistance of respirations by gentle manual compression of the breathing bag provides more flexibility in the management of the anesthesia.

A cuffed tracheal catheter has been used for several of the older patients in the hope of providing a completely closed circuit. This hope has not always been realized, and we still prefer to use the largest plain tracheal tube which will comfortably fit the glottic opening. For infants considerable care must be observed in selecting a tube of the proper length as well as the correct bore. The trachea in the infant is short, and too long a tube may pass into a main bronchus, thus predisposing to collapse of the opposite lung. The catheter may rest on the carina and give rise to irritation and cough. Conversely, the necessarily short tracheal catheter may easily slip out of the trachea during operation. It should be securely fastened in place. The bore of the infant tracheal catheter is, of necessity, small and may readily become obstructed with mucus. Judicious suction is important. Since the level of anesthesia is light, suction not infrequently gives rise to coughing; therefore it should be performed at a period during the operation when no harm may result, or the surgeon should be warned of the need for suction in order that he may stop operating during the procedure. During construction of the anastomosis suction may be dangerous in that a cough at this time may cause the suture to tear the thin-walled vessels. A properly premedicated patient requires suction infrequently during surgery. The aspirating catheter must be small enough not to occlude the lumen of the tracheal tube. We have found discarded ureteral catheters fitted with a blunt 15 gage needle to be very satisfactory for the infant tracheal tubes.

While most of these patients fall into the category of tetralogy of Fallot, many bizarre cases are seen. It has been said that these patients are not problems from the standpoint of anesthesia but simply problems in physiology. We believe that the two problems are inseparable. It is essential that the anesthetist

have a thorough understanding and appreciation of the physiologic problems involved in this type of surgery if safe, smooth anesthesia is to be obtained. In such conditions as atresia of the pulmonary artery, absence of one or both pulmonary arteries, or a pulmonary artery having no connection with the heart, the circulation to the lungs is by bronchial arteries rather than by pulmonary arteries. Under any one of these conditions induction is almost always prolonged and may require percentage mixtures of cyclopropane with oxygen as high as 70 to 80 per cent for a brief period. For example, an infant, aged 6 weeks, required thirty minutes for induction despite an 80 per cent cyclopropane-oxygen-ether mixture for a portion of the induction period. No preliminary blood flow studies had been attempted in this intensely cyanotic child, but he probably had an extremely low pulmonary blood flow. Anesthesia for this case was maintained at little more than analgesic level. His surgical course was smooth, and the postoperative period was uneventful after the construction of an innominate-pulmonary artery, end-to-side anastomosis. Once anesthesia has become established in this group of patients, it may be maintained with very low concentrations of anesthetic agents. The recovery period is usually slightly prolonged.

A catheter attached to a three-way stopcock is inserted into the pleural cavity when the costal cartilages have been approximated on chest closure. The lungs are fully inflated and maintained in expansion during chest closure. Pressures employed do not exceed 15 cm. of water with the average between 6 and 12 cm. Any residual air remaining within the pleural cavity is aspirated through the intercostal catheter when the skin closure has been completed. After removal of the aspirating catheter, the pharynx and trachea are aspirated to cleanse the respiratory tract of secretions. During extubation the suction catheter remains within the tracheal catheter. Upon occasion the tracheal catheter has been left in situ when there has been respiratory difficulty or a stormy immediate postoperative course has been anticipated.

## COMPLICATIONS

Bradycardia is the commonest complication noted but is encountered much less frequently than previously in the typical tetralogy of Fallot. Gradual deflation of the lung when the pleural cavity is entered appears to minimize the incidence of bradycardia at this step of the operation. During dissection of the mediastinum, arrhythmias as well as bradycardia may appear. This may be the most hazardous stage of the operation from the anesthetic standpoint, and too much emphasis cannot be placed on the importance of close and continued visual inspection of the heart by the anesthetist throughout the procedure.

If bradycardia is noted promptly, it may usually be corrected quickly by a brief rest period with increased inflation of the lungs and a slight increase in the oxygen tension. In the past we have administered atropine intravenously at the first indication of cardiac slowing. We now believe that this slowing is primarily due to lowered oxygen tension and not necessarily to vagal stimulation. If increased oxygen tension does not immediately correct the condition, atropine is ad-

ministered. By adopting such a plan, we have administered atropine much less frequently in the last 100 cases. Electrocardiographic tracings are extremely helpful in warning of impending danger, thus permitting the early use of corrective measures and avoiding a serious or fatal crisis. When effective pumping action of the heart is lost, it is important to know whether the cause is simple cardiac arrest or ventricular fibrillation. Direct observation and electrocardiography give definite information, on the basis of which specific therapy can be carried out. In simple arrest various cardiac stimulants such as epinephrine may be used in moderation to supplement the vitally important periodic manual compression of the heart. Should fibrillation be present, this must be abolished before stimulants are given; otherwise the condition may be aggravated. It is the anesthetist's function to maintain an adequate exchange of oxygen by rhythmic pulmonary inflation and to keep the surgeon informed at frequent intervals of the patient's condition.

While realizing fully the important information provided by electrocardiography and by the newer development of oximetry, there are some instances when such devices are unavailable or out of order. It is under such circumstances that direct observation is even more important than usual. For example, a 20 year old girl was observed by the anesthetist to show an improvement in color when the pulmonary artery was clamped proximal to the point of an end-to-side subclavian-pulmonary anastomosis. That is, the blood flow was to one lung only. Although the reason for the improvement in color was obscure, the observation was proved to be accurate. The pulmonary artery was then ligated and divided proximal to the anastomosis, converting it into an end-to-end type. The ultimate result was excellent with marked improvement in color.

In a recent report[1] on a study of direct electrocardiographic tracings made on 175 consecutive cases, the terminal cardiac mechanism was recorded in seven children who died during operation. In practically every case the terminal asystole was preceded by one or more specific preterminal phenomena which included:

1. Sinus or AV nodal bradycardia which either failed to revert to normal after administration of atropine intravenously or which recurred after atropine administration.
2. Complete dissociation or idioventricular rhythm.
3. Ventricular tachycardia.
4. Complete bundle branch block.
5. Changes which gave evidence of myocardial anoxia.

A falling blood pressure without hemorrhage or significant changes in the heart rate, a decreasing arterial oxygen saturation, and mechanical dilatation of the heart (occasionally with normal electrocardiogram) may be interpreted as evidence of impending terminal asystole.

Premature ventricular systoles may lead to ventricular tachycardia or fatal ventricular fibrillation. Such arrhythmias usually revert to normal when the anesthetic is changed from cyclopropane to ether-oxygen or oxygen alone.

Cerebral thrombosis is an ever present hazard which may become

1. Ziegler, R. F.: The cardiac mechanism during anesthesia and operation in patients with congenital heart disease and cyanosis. Bull. Johns Hopkins Hosp. **83**:237-274, Sept. 1948.

manifest rapidly or quite slowly. It is essential that careful and frequent observation of the pupils be made throughout the operation. Cerebral accident is to be anticipated if the innominate or carotid artery is occluded. Heparin or Dicoumarol was occasionally administered, prophylactically, preoperatively to such patients earlier in the series, but these drugs are now reserved, almost exclusively, for instances of obvious cerebral thrombosis after operation. If it is believed that cerebral damage has occurred, the anesthesia is lightened and in some cases may be discontinued completely. Assist of respiration may be continued with oxygen alone. Intravenously administered morphine is helpful in controlling the gasping or jerky respirations associated with cerebral accident.

The following case report illustrates the management of a variety of complications, despite which the result was ultimately fatal.

CASE 1.—Ninety minutes after the start of cyclopropane-ether-oxygen anesthesia in a 6 year old white girl with tetralogy of Fallot, the respirations suddenly increased from 22 to 44 per minute and became jerky in character. The pupils were enlarged and asymmetrical. It was suspected that she had suffered a cerebral accident. After two hours of anesthesia the temperature was found to be 104.4 F. despite the use of an ice bag and frequent changes of the canister. Her respirations gradually slowed but remained jerky. It was necessary to use the innominate artery for construction of the anastomosis. Three minutes after release of the occluding clamps, on completion of the anastomosis, the blood pressure fell sharply, and she went into cardiac arrest. Cardiac massage, occlusion of the anastomosis, increased lung ventilation with oxygen, and intracardiac injection of procaine 1 per cent followed by adrenalin, promptly restored cardiac action. A second cautious partial opening of the anastomosis nearly stopped the heart again, and it was decided not to open the anastomosis but rather to ligate it. The pulse was counted at 160 when chest closure was begun, but the blood pressure could not be determined. After approximation of the costal cartilages the heart suddenly stopped a second time. Prompt application of resuscitative measures once more restored the cardiac action, and the chest was quickly closed. At completion of the operation the color was very poor, the pupils widely dilated, no reflexes were present, and the pulse was barely perceptible. Blood pressure readings were not obtainable. She was placed in an oxygen tent and given supportive treatment, but her condition became steadily worse, and she died two and one-half hours after operation. It appeared that she had compensated for the initial cerebral difficulty, but her heart was unable to tolerate the sudden diversion of such large amounts of blood as occurred with an innominate to pulmonary artery anastomosis.

Decreased elimination of carbon dioxide is consequent to partial or total collapse of one lung. This must constantly be guarded against, especially in the small child and infant. Very young patients are markedly susceptible to slight alterations in the carbon dioxide level in the blood. Efficient alveolar ventilation and minimal dead space must be maintained at all times. A canister of suitable dimensions for the tidal volume should be employed and changed frequently. This frequent changing of canisters reduces the likelihood of carbon dioxide accumulation and at the same time minimizes the degree of heat retention. Resting the canister on an ice bag is of benefit in combating a tendency toward hyperpyrexia. Convulsions are usually the result of either carbon dioxide excess or heat retention.

Not infrequently systemic vessels are found in unusual positions and identification may be quite difficult. The anesthetist may materially assist the surgeon with such problems if note has been made of the temporal and carotid pulsations bilater-

ally before the start of anesthesia. Subsequent variations in the character of the pulse in these vessels may afford the surgeon valuable information enabling him to make positive identification.

During exploration of the systemic vessels, sympathetic stimulation may produce a dilatation of the pupil on the affected side. The pupil then gradually contracts, and the opposite pupil is observed to be the larger. A number of patients have shown such a Horner's syndrome, but only rarely does it persist beyond the period of hospitalization.

Patients with derangement of the conducting mechanism of the heart are now anesthetized with Vinethene-ether-oxygen.

Case 2.—A deeply cyanotic, markedly incapacitated, white girl, aged 22, came to operation with a complete heart block. She was fully informed of the great risk of surgery in her case but insisted on operation. Anesthesia was carried out in the usual manner with cyclopropane-ether-oxygen. Induction was smooth, and no change was noted in the pulse or blood pressure. Immediately following easy intubation the systolic blood pressure fell from 110 to 80 mm. Hg. The diastolic pressure could not be determined. Repeated periods of cardiac asystole developed. After fifteen minutes of ether-oxygen anesthesia the blood pressure rose to 120 mm. Hg, but the cardiac irregularities continued, and the operation was cancelled. A very grave prognosis was given. Nine months later she returned demanding operation. On this occasion induction was carried out with open drop Vinethene followed by open drop ether until intubation had been accomplished. Anesthesia was then maintained by the to-and-fro technic with an ether-oxygen mixture. Although the heart block persisted, no additional gross changes were detected by the electrocardiograph. The blood pressure, which could be determined only by palpation, was maintained at 100 mm. Hg for the first hour and a half and then fell to 80 mm. Hg, where it remained for the duration of the anesthesia, which was four hours and ten minutes. No supportive therapy was required during the operation with the exception of the usual fluid replacement. She made a slow but excellent recovery and continued to show marked improvement seven months later.

Respirations typical of bronchial spasm have been observed frequently in patients found to have transposition of the great vessels. For some reason as yet unknown, inflation of the lungs in such patients is difficult.

Since the last report 120 anesthesias have been administered for the Blalock anastomosis operation. One of the patients was the youngest in the entire series, a boy 6 weeks of age.

### Postoperative Course

Croup is a common postoperative complication and is noted in approximately 20 per cent of all cases. Contrary to accepted theories, the incidence is no higher in infants than in the older age group. There have been no episodes of laryngeal edema.

Horner's syndrome is a not uncommon complication. It clears fairly promptly without treatment.

Cardiac decompensation occurs in a small percentage of cases.

Cerebral thrombosis has been the cause of three fatalities in the last 120 cases. That this is not always fatal is shown by the course of a 5 year old girl in whom hemiplegia developed twelve hours after surgery. On an anticoagulant regimen the signs gradually cleared, and there were no residua on discharge three weeks postoperatively. Several other patients recovered after similar therapy for minor cerebral thrombosis in the postoperative period.

Subcutaneous emphysema is rarely noted. Pneumothorax has

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# ANESTHESIA FOR CHILDREN UNDERGOING TONSILLECTOMY

Mary A. Costello, R.N.*
Cincinnati

One of the most neglected phases of the field of anesthesia is the management and safe administration of anesthesia for the reputedly simple operation of tonsillectomy in children. Laymen, as well as many doctors and nurses, classify tonsillectomy as a "minor" surgical procedure, requiring little or no preparation of the patient, anesthesia by anyone who can drop ether, and inadequate postoperative care, keeping the patient in the hospital only long enough for him to recover from the anesthesia. One wonders what the statistics would show were we able to measure the permanent cerebral and cardiac damage done to these children by anoxia resulting from poorly administered anesthesia and the lack of postoperative nursing care. The purpose of this article is to voice a protest against the usual careless management of anesthesia for tonsillectomies and to enumerate the precautions that would, to my mind, obviate many of the dangers of this procedure.

Psychologists tell us the basis of all fear is insecurity. In no class of patient is this so clearly exhibited as in children brought into the hospital for tonsillectomy two hours before operation. These children are totally unprepared to be separated from parents and carried off to an entirely different world completely foreign to them. How often have we heard the familiar cry of terror-stricken children echoing through the corridor as they are brought to surgery? What is the best psychologic approach to these little adults; how can a stranger with white gown and mask gain their confidence in such a short time?

## PREOPERATIVE PREPARATION

A quiet induction room with toys to divert the child's attention gives the anesthetist an opportunity to establish a good relationship with him and to dispel fear and apprehension. She can also explain to the patient that he is to be put to sleep, why, and in just what way this is best done. Stories may be told about pilots' needing oxygen, and the patient shown how he can imitate these famous men by holding a mask over his face and breathing a pleasant-smelling gas. By becoming substitute parents for a short while to such a child, whether or not he exhibits fear, we anesthetists may lay the foundation for the future attitude of that patient toward surgery and anesthesia.

Although some surgeons believe it is unnecessary to admit the patient the night before operation, there are others who believe that if the patient is admitted the previous night he becomes more accus-

*Instructor in Anesthesia, College of Medicine, University of Cincinnati, and Director of Anesthesia, Cincinnati General Hospital and Children's Hospital.

tomed to his new environment and is assured of longer rest in the morning. By this arrangement, one may also make certain that fluids and food are withheld for at least twelve hours preoperatively. The last is of utmost importance in the prevention of complications from vomiting and aspiration. The dangers of aspiration need not be reviewed for anesthetists who realize that this is a common cause of anoxia and sometimes death.

Too often the patient is given only a cursory physical examination and is brought to the operating room with an inadequate evaluation of his ability to tolerate an anesthetic or withstand a surgical procedure. A urinalysis should always be done so that the surgeon and the anesthetist may know the efficiency of the patient's renal function, since the presence of abnormal amounts of albumin or sugar is one of the primary contraindications for the use of the volatile anesthetic agents. Clotting time should be ascertained, and further blood studies done on patients presenting symptoms of anemia. Every patient also deserves the protection of an examination of the heart and lungs, to be done on admittance to the hospital.

### Premedication

There has always been, and probably always will be, a controversy among surgeons, pediatricians, and anesthetists concerning premedication for children, and there is much to be said for and against its use.

Morphine is frequently recommended for the purpose of decreasing the metabolic rate, or lowering the demand of the body tissues for oxygen, to obtain the desired level of narcosis quickly and safely. Used to lessen the fear and apprehension of the patient, it is my belief that morphine is poorly tolerated by children under 5 years of age and that clinically arrhythmia is not an unusual sequela. It is difficult to judge the margin of safety between adequate sedation and overdosage. Morphine being a primary respiratory depressant, it is not unusual to see a decreased respiratory rate and volume after its use. The shorter acting barbiturates can be used more safely to obtain the desired hypnotic effect without the dangers of the respiratory depression seen with morphine. Clinically, we have found that children under 8 years of age have adequate sedation with nembutal, gr. ¾, given orally or rectally, half an hour before operation. However, in children over 8 years of age anesthesia is more satisfactorily induced and maintained if morphine is used in combination with atropine or scopolamine. Barbiturates are not used if morphine is given.

For the extremely excited patient induction with small amounts of pentothal sodium, 2½ per cent solution, given intravenously with a small gage needle, has proved to be more satisfactory than induction with some of the more unpleasant and slower volatile agents with a prolonged excitement period. Although pentothal sodium is generally contraindicated for small children, we have seen no deleterious effects from its cautious use. Here the shorter acting barbiturates in combination with adequate doses of atropine or scopolamine have many advantages as preanesthetic medication, namely, protection against laryngospasm, sedation without depression, inhibition of secretions, and relaxation of the smooth muscles of the bronchi, resulting in a slight widening of the airway. The

following table of dosage is one which we use in our hospital.

As we all know, no such chart should be followed rigidly, but the dosage should be varied according to the individual needs of each patient.

PREOPERATIVE MEDICATION FOR CHILDREN UNDERGOING TONSILLECTOMY

| AGE | NEMBUTAL | | MORPHINE | ATROPINE OR SCOPOLAMINE |
|---|---|---|---|---|
| YR. | GR. | | GR. | GR. |
| Less than 1 | none | | none | 1/600 |
| 1-2 | none | | none | 1/450 |
| 3-5 | 3/4 | | none | 1/400 |
| 6-10 | 3/4 | *or* | 1/16 | 1/300 |
| 11-14 | none | | 1/8 | 1/200 |

The most commonly used anesthetic agent for tonsillectomy is unquestionably ether. There are a variety of technics used to deliver an anesthetic agent to the patient, and likewise a wide range of drugs used for induction. I am aware that most anesthetists are familiar with the pharmacology of the anesthetic agents about to be discussed, and I shall confine my discussion to their effects in tonsillectomy.

### DIVINYL ETHER (Vinethene)

Used for induction because of its rapid action, it is probably the safest of all the volatile agents because of its negative effects (without anoxia) on the heart or circulation. It does, however, stimulate secretions, and it should never be used without benefit of premedication with atropine or scopolamine. Adequate suction apparatus should be available, not only in the operating room but also in the induction room. In my opinion, Vinethene is not the ideal agent for induction, but it is most effective when quick induction is needed, such as when the anesthetist has little time to induce anesthesia with slower but more pleasant technics. Even though the excitement period is shortened by the use of Vinethene, the occurrence of crying or struggling is almost inevitable and, as a general rule, is more intense. If premedication is not used, it is not unusual to see the child exhibit gross, tonic muscle spasm.

### ETHYL CHLORIDE

This is one of the most promiscuously used induction agents, probably because it has been in existence longer and is more widely known than the less toxic agent Vinethene. Its most toxic effect is a decrease in cardiac output due to direct depression of the myocardium. Reports in the literature link cardiac failure with the use of ethyl chloride, but, although I disapprove of its use, observation reveals that this complication is extremely rare. The reason for my disapproval is that I believe it is wiser to use an agent having a wider margin of safety.

### NITROUS OXIDE

This gas, in combination with adequate oxygen, is the ideal agent for pleasant and safe induction. It has none of the disadvantages mentioned previously. Its only disadvantage is that it may be time consuming. Although some anesthetists employ the anoxic technic using 100 per cent nitrous oxide, I believe this to be most dangerous and unnecessary. In our hospital the following technic is used:

The patient is first schooled in what to expect by being shown the

mask and being told that he can emulate aviators who must wear a similar mask at high altitudes. To dispel fear, he is allowed to assist in holding the mask on his face. The initial concentration is 90 per cent nitrous oxide and 10 per cent oxygen and is reduced to 80 per cent nitrous oxide and 20 per cent oxygen as soon as time has been allowed for displacement of the inert nitrogen in the lungs. During this time the exhalation valve is left open to release the excess pressure of gas. Ether is then added to the mixture as the patient tolerates it. This procedure is continued until the first plane of the third stage is well established. At this time the anesthetic is changed to ether given by the open drop technic. If he is not sufficiently anesthetized before this change is made, all that has been accomplished may be undone by his quick emergence in this brief period. When this happens, coughing and vomiting may ensue.

### ETHER

It is rather generally accepted that ether is the anesthetic of choice for tonsillectomy. Certainly it is the safest and most reliable. It is used, as stated before, for maintenance after induction is accomplished with another agent. However, ether may be used satisfactorily for both induction and maintenance. If it is administered slowly and skilfully, its reputedly unpleasant odor is tolerated without manifestations of suffocation. Adequate premedication enhances the smoothness of induction. Although it may seem superfluous to discuss the technic of open drop ether anesthesia, there is one phase that varies enough to deserve mention, that is, the method of protecting the eyes. We have found the most effective protection to be the most simple: a dry, soft towel over the eyes, to cover the bridge of the nose, and long enough so that either free end may be brought down to surround the mask under the chin. In observing 1,200 cases of open drop ether, I have found *no* conjunctivitis or burns of the eyes or face associated with the use of this technic. I also believe that a finer and more regulated flow of ether is obtained with the use of a wick than with a safety pin.

Ether may be delivered to the patient with the insufflation technic by means of a gas machine or a mechanical unit. To my mind, regardless of the means used, oxygen, 3 to 4 L. per minute, should be given simultaneously. This can be accomplished when a mechanical unit is used by connecting an oxygen cylinder to the insufflation hook by means of a Y connection, one branch coming from the unit and the other from the oxygen cylinder. From the anesthetist's viewpoint intratracheal insufflation is by far the safest method. Regardless of position, bleeding, or mechanical obstruction incident to the procedure, the patient is assured a clear airway and adequate pulmonary ventilation. Conversely, most surgeons dislike this technic because the presence of a tube makes operating conditions cumbersome. Also, some surgeons disapprove of intubation in the younger age group. However, in a period of seven weeks, we used oral intratracheal insufflation for fifty cases. The ages ranged from 3 to 9 years, and the average procedure lasted forty-five minutes. In the second plane of anesthesia a Magill catheter was introduced, and the anesthesia maintained with nitrous oxide, oxygen, and ether. The patients, as compared with

those in whom intubation was not done, vomited less and were reacting fully when returned to the ward. The only complication was slight hoarseness in one child for five hours postoperatively, but I believe this was due to trauma caused by the anesthetist in handling the laryngoscope rather than to glottic edema caused by the intratracheal tube.

### COMPLICATIONS

Lastly, complications and their treatment deserve special emphasis. The most common are: (1) aspiration of blood, foreign bodies, mucus, or vomitus; (2) mechanical obstruction resulting in anoxia or anoxemia.

If the anesthetist is aware of aspiration, suctioning by means of an intratracheal tube should be instituted as soon as possible. If the obstructive symptoms are not relieved by this measure, bronchoscopy should be done immediately. As a precaution against postoperative aspiration, the anesthetist should accompany every patient from the operating room to the ward and make sure that someone will remain with the patient until he is reacting fully.

Mechanical obstruction is usually due to improper depression of the tongue or hyperextension of the jaws with the mouth prop. If it is impossible for the surgeon to proceed without causing such obstruction, an intratracheal tube should be inserted to assure an adequate airway. Too many times the surgeon and anesthetist will allow the patient to have repeated bouts of cyanosis without taking measures to eliminate the cause. Although the patient may recover without apparent ill effects, we have no way of measuring the amount of temporary or permanent cerebral and cardiac damage that has been caused by their neglect.

A rare, but with very few exceptions, fatal complication is that of ventricular fibrillation or sudden cardiac arrest. The only sure treatment is prevention. A few isolated cases of successful cardiac resuscitation have been reported, but they are in the minority. Nevertheless, the success of the procedure, in my opinion, makes it obligatory that every conscientious anesthetist be familiar with its use and be able to fulfil her duty of establishing adequate pulmonary ventilation.

### SUMMARY

Many needless deaths occur every year because of improper management of anesthesia for tonsillectomies in children. An intelligent psychologic approach, adequate premedication, and capable management contribute to safer anesthesia.

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# INHALATION METHOD OF PENICILLIN ADMINISTRATION

Opal M. Schram, R.N.*
Chicago

The inhalation method of administration of drugs is not new to the anesthetist. She has long appreciated the efficiency of lung tissue as an absorptive surface. It has been estimated that there are approximately 55 sq. M. of respiratory epithelial surface in the lungs. This large expanse of alveolar membrane offers an easily available method of drug administration that is especially adapted to the treatment of diseases of the respiratory tract.

Medical literature reveals an interest in this method dating from the early twentieth century. The drug that featured most extensively in the early reports was epinephrine, used for the relief of asthma. Other drugs were studied, among them sulfanilamide, which was reported in 1934. A 5 per cent solution of the drug was nebulized and inhaled as a treatment for bronchopulmonary suppuration. However, the method was not widely used until the advent of penicillin. Since penicillin is a highly absorbable bacteriostatic agent known to be effective when brought into contact with certain infecting organisms, it was logical to attempt to apply it directly to the tissues of the respiratory tract by the inhalation method. The possibilities of this type of treatment were immediately recognized and attracted the interest of many investigators. The reports of the results of these investigations are appearing in such numbers that the problem of the average reader is to discover the necessary information for clinical use. The purpose of this communication is to summarize the conclusions of some of these workers, and to present the methods employed in this hospital* in the application of this type of therapy.

The administration of drugs and antibiotics by inhalation is commonly referred to as "aerosol therapy." Aerosols may be defined as finely divided particles suspended in air or some other gas. Most of the reported work on aerosols has been with aerosolized liquids. However, aerosols can be made by the suspension of finely divided solid substances. An aerosol of penicillin may be inhaled in the form of either a mist or a dust. Both methods will be presented.

Some investigators believe that the particle size of the aerosol is important in the efficacy of the treatment. Most of them are of the opinion that the smaller the particles the farther they will be carried into the respiratory tract. Aerosolization of a solution of penicillin was reported in the work of Bryson, Sansome, and Laskin[1] in 1944. These authors found that penicillin delivered as an aerosolized

*Department of Anesthesia, Wesley Memorial Hospital.

1. Bryson, V.; Sansome, E., and Laskin, S.: Aerosolization of penicillin solutions. Science 100:33, July 14, 1944.

spray penetrated the lungs, diffused into the blood stream, and was excreted in the urine. Hagens, Karp, and Farmer[2] reported on the results of the inhalation method of penicillin therapy in respiratory tract infections, and Barach[3] and his coworkers have written extensively on the subject. These, and other investigators, used varying methods for producing an aerosol of penicillin solution and administered the drug in varying dosage. All secured results that indicated the method to be of definite value, particularly in the treatment of respiratory tract diseases.

### AEROSOL OF PENICILLIN SOLUTION

All that is required to produce an aerosol is a suitable nebulizer containing the solution of the drug, and a force to operate it. This may be accomplished by means of a simple hand bulb attached to the nebulizer, but this is tedious and tiring for the patient. The commonest method is to blow a measured flow of compressed air or oxygen through the nebulizer, utilizing a tank of air or oxygen, a reducing gage, and flowmeter. A considerable number of glass and plastic nebulizers, such as the Vaponephrin and the DeVilbiss 40, are manufactured and advertised. The particle size of the mist is somewhat smaller from the Vaponephrin nebulizer, but both are considered therapeutically effective. Recently, much more expensive and complicated kinds of apparatus have been manufactured in attempts to improve the efficacy of aerosol therapy. Whether this has been accomplished is a point very much in question.

The aerosol may be inhaled directly from the mouth of the nebulizer or from a mask and bag into which the nebulizer is inserted. If the latter method is used, rebreathing should be provided for, and any type of oxygen therapy mask, such as the B. L. B. or the O. E. M., may be employed. Attempts have been made to conserve the drug during exhalation by means of a Y adaptor. When the opening is occluded by holding the finger over it, the flow of oxygen is directed through the nebulizer; when the finger is removed, the oxygen escapes through the opening and nebulization ceases. Thus the patient is instructed to hold the finger over the opening and inhale, remove the finger and exhale.

Most investigators now recommend the use of crystalline sodium penicillin for inhalation therapy. It is more readily nebulized than is sodium penicillin, and it is more stable. The dosage will be determined by the attending physician, and it is usually between 150,000 and 300,000 units in twenty-four hours. It is believed that therapeutic blood levels may be obtained with such dosage. The concentration of the solution and the length and frequency of the treatments will depend upon the dosage desired and the pathologic condition present in the respiratory tract. An oxygen flow of 5 L. per minute will nebulize approximately 1.5 cc. of penicillin solution in five minutes. This is taken into consideration in the planning of a course of treatments. Concentrations of penicillin varying from 5,000 to 250,000 units per cc. have been nebulized

2. Hagens, E. W.; Karp, M., and Farmer, C. J.: Inhalation method for penicillin therapy. Arch. Otolaryng. **41**: 333-336, May 1945.

3. Barach, A. L.; Silberstein, F. H.; Oppenheimer, E. T.; Hunter, T., and Soroka, M.: Inhalation of penicillin aerosol in patients with bronchial asthma, chronic bronchitis, bronchiectasis and lung abscess. Ann. Int. Med. **22**: 485-509, April 1945.

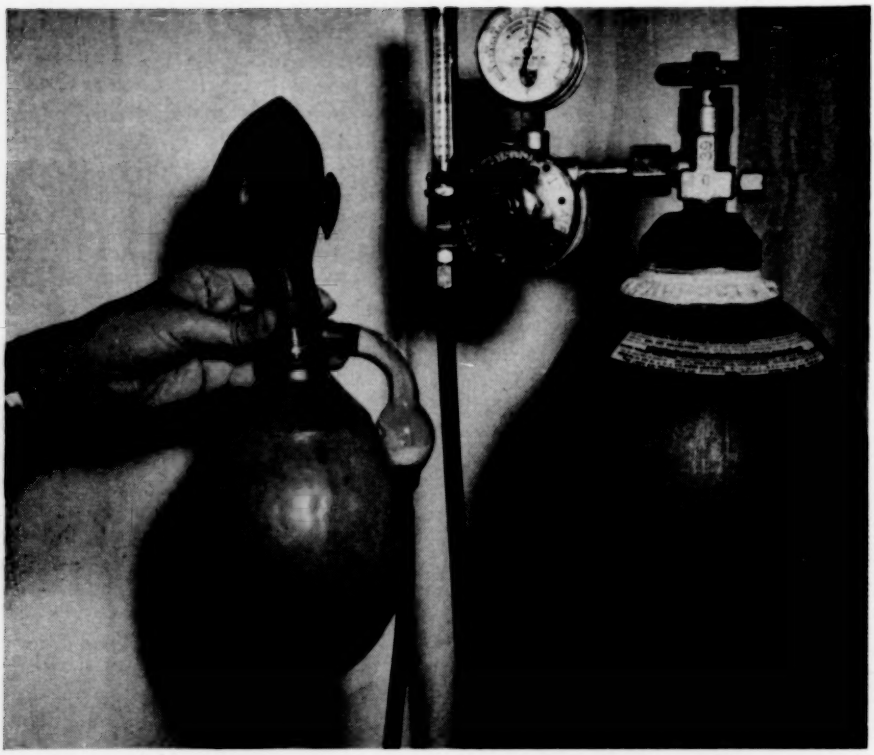

Fig. 1.—Oro-nasal mask, DeVilbiss 40 nebulizer, and rebreathing bag attached to an oxygen tank with reducing gage and flowmeter, for administration of an aerosol of penicillin solution.

and inhaled.[4] Probably the high concentrations are to be avoided because they may increase the possibility of allergic reactions and the chances of encountering the mechanical difficulty of a clogged nebulizer. The very low concentrations are time consuming for the patient, but may be more beneficial in the treatment of diffuse suppurating bronchiectatic lesions in which it is difficult to reach all parts of the lungs. Since the dilute solution is more frequently applied, a more even concentration in the tissue and blood may be obtained.

4. Abramson, H. A.: Principles and practice of aerosol therapy of the lungs and bronchi. Ann. Allergy **4**: 440-456, Nov.-Dec. 1946.

The method used extensively in this hospital in the past has included the oro-nasal mask, the DeVilbiss 40 nebulizer, and rebreathing bag attached to an oxygen tank as illustrated (fig. 1). The penicillin is dissolved in physiologic saline so that each cubic centimeter contains 8,000 units. Five cubic centimeters of solution is placed in the nebulizer at one time. The patient is instructed to apply the mask to the face, turn the oxygen to a flow of 5 L. per minute, and breathe the nebulized penicillin for five minutes out of every hour during the day, and at night if he wakens. This schedule of treatments delivers a dosage of about 200,000 units in

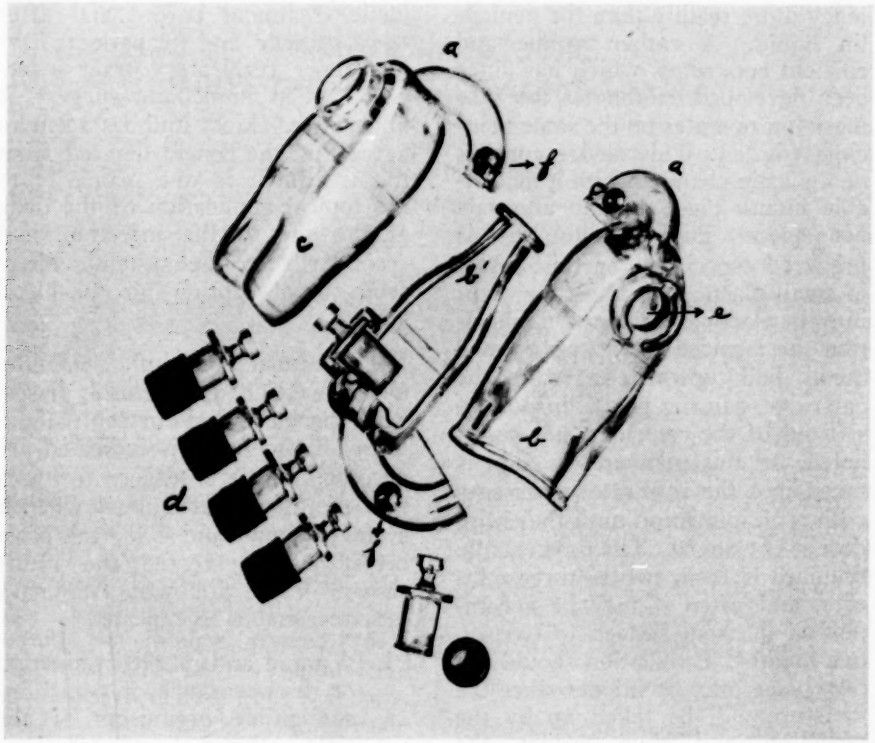


Fig. 2.—Plastic chamber (*a*) with a detachable mouth piece (*b* and *b'*) and an alternate nose piece (*c*). Small plastic cartridges (*d*) fit into plastic chamber (*e*). Small metal ball (*f*) strikes cartridge on inhalation.

twenty-four hours. The schedule and the concentration can be varied as indicated by the needs of the patient.

### Aerosol of Penicillin Dust

The type of treatment described has required hospitalization of the patient or the rental of cumbersome apparatus. Because of this inconvenience and increased expense, a simpler method was desirable. Accordingly, Krasno, Karp, and Rhoads[5] studied the possibilities of fine penicillin dust. The experimental work was begun in October 1946 and carried on under the direction of the Anesthesia Department at the Wesley Memorial Hospital. It was found that finely powdered penicillin could be aerosolized by the patient's respiration and inhaled. Clinical and bacteriologic results were comparable to those obtained by the inhalation of aerosolized penicillin solution.

The apparatus first used was an adaptation of an oro-nasal mask which permitted the inhaled air to be drawn through the powdered penicillin. The penicillin used was crystalline sodium penicillin, processed to number 50 to 100 mesh particles. The crystalline form was found to be less hydroscopic than the amorphous sodium pencillin salt and could be stored at room temperature without losing its po-

5. Krasno, L.; Karp, M., and Rhoads, P. S.: Inhalation of penicillin dust. J. A. M. A. **138**: 344-348, Oct. 2, 1948.

tency more readily than the penicillin liquid. A rather simple and efficient apparatus, which has since been developed, eliminates the face mask but operates on the same principle (fig. 2). This device consists of a plastic chamber with a detachable mouth piece and an alternate nose piece. The penicillin dust is prepared especially for this device in small plastic cartridges which fit into the plastic chamber. On inhalation the inspired air draws a small metal ball upward to strike the cartridge, causing penicillin dust to sift out of the cartridge and be inhaled. In this manner penicillin is taken into the respiratory passages with each inhalation until the entire dose is consumed. The time usually required is from two to three minutes, and often it may be accomplished in from sixteen to twenty-five breaths. Exhalation should not take place into the inhaler since the moisture will be taken up by the penicillin and thus reduce the amount available. The patient should be instructed not to eat or drink for about an hour after the treatment to avoid washing the drug from the oral part of the pharynx. This apparatus has largely replaced the mask in this hospital.

## SUMMARY OF RESULTS

Investigators have reported favorable results from the inhalation of penicillin aerosol in infections of the upper respiratory tract, such as acute and chronic pharyngitis, laryngitis, and acute and chronic sinusitis, and in conditions involving the lower respiratory tract, such as acute and chronic bronchitis, bronchiectasis, bronchial asthma with a bacterial basis, pneumonia, and lung abscess. It has been used with apparent benefit as a prophylactic treatment before and after chest surgery, and for patients having upper respiratory tract infections when immediate surgery is imperative. Most authors seem to agree that the benefit derived from the treatment is due primarily to the topical application of the drug at the site of the infection, and secondarily to the systemic effect from the absorption into the blood stream.

The inhalation of penicillin, either wet or dry aerosol, has a very special appeal for the patient. Many for whom it is indicated are chronic sufferers, eager to try a new treatment, particularly when it seems so simple and so logical. Most investigators agree that the results shown in the following summary may reasonably be expected.

1. A rapid and marked reduction or disappearance of penicillin-susceptible organisms of the nose, throat, and tracheobronchial tree occurs.
2. Clinical improvement of some degree takes place in all but a very low percentage (3 per cent in one report) of cases, and in a high percentage (73 per cent) the improvement is marked.[6]
3. Allergic reactions are few, tending toward systemic reactions, such as dermatitis, fever, and dyspnea, with the penicillin mist treatment, and toward local reactions, such as stomatitis and pharyngitis, with the dry aerosol. If the need for the therapy is great, minor reactions may be controlled with an antihistaminic drug and the treatment continued

(*Continued on page 76*)

6. Ibid.

# ANESTHESIA STUDIES WITH THE PNEUMOTACHOGRAPH

Leslie Silverman, Sc.D.*
Boston

Very few anesthetists are familiar with the pneumotachograph. In fact very few clinicians are familiar with this device. Many devices have been and are used in physiologic laboratories and clinics for measuring lung volume and volume of air breathed per minute or per breath. This equipment, however, gives very little information about the character of breathing. During World War II we developed a simple apparatus which would not only give the volume data but also information as to the character and flow taking place in each breath. This apparatus represents an improved form of pneumotachograph which can be used in the clinic, operating room, and general hospital. It is called a pneumotachograph because it records the speed, or velocity, of air flow into and out of the lungs. This name was originated by Alfred Fleisch,[1] a Swiss physiologist, who devised an early apparatus for recording air flow patterns (pneumotachograms) during breathing.

During World War II we used this apparatus in several forms[2, 3, 4] for recording air flow of normal subjects in order to ascertain the range of air flows for aviation oxygen and chemical warfare respiratory equipment. Since then we have applied the clinical pneumotachograph to studies of respiratory diseases [5, 6, 7] and diseases in which there is respiratory involvement. Studies are now in progress on anesthetized patients.

In this article I shall describe the instrument and then discuss its application to anesthesia studies.

## CLINICAL PNEUMOTACHOGRAPH

The clinical pneumotachograph is a device used to record instantaneous air flow to and from the lungs. It consists of two essential parts which we shall denote as the "prime mover" and the "recorder." The prime mover is that part of the apparatus which converts air movement into a form of energy which can be recorded instantaneously.

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Read before the Fifteenth Annual Meeting of the American Association of Nurse Anesthetists, Atlantic City, Sept. 22, 1948.

*Associate Professor of Industrial Hygiene, Harvard School of Public Health.

1. Fleisch, A.: Der Pneumotachograph; ein apparat fur geschwindigkeits registrierung der atemluft. (The pneumotachograph; an apparatus for registration of velocity of respiration.) Pfluger's Arch. f. d. ges. Physiol. **209**: 713, 1925.

2. Silverman, L.; Lee, R. C.; Lee, G.; Drinker, K. R., and Carpenter, T. M.: Fundamental factors in the design of protective respiratory equipment. Inspiratory air flow measurements on human subjects with and without resistance. O. S. R. D. Report No. 1222, Jan. 1943.

3. Lee, R. C., and Silverman, L.: An apparatus for measuring air flow during inspiration. Rev. Sci. Inst. **14**: 174, 1943.

4. Silverman, L.; Plotkin, T., and Lee, G.: A field instrument for measuring volume and instantaneous flow rate of inspired air. Rev. Sci. Inst. **19**: 513, 1948.

5. Silverman, L.; Lee, R. C., and Drinker, C. K.: A new method for studying breathing, with observations upon normal and abnormal subjects. J. Clinical Invest. **23**: 907, 1944.

6. Silverman, L.: Respiratory air flow characteristics and their relation to certain lung conditions occurring in industry. J. Indust. Hyg. & Toxicol. **28**: 183, 1946.

7. Rao, M. N., and Silverman, L.: Respiratory patterns in tuberculosis. Am. Rev. Tuberculosis. **54**: 574, 1946.

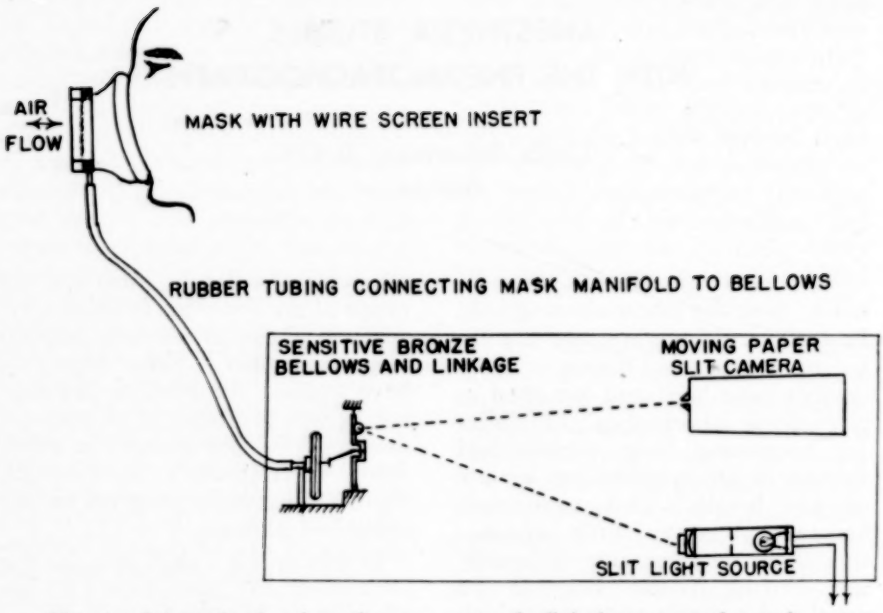


Fig. 1.—Schematic drawing of components of clinical pneumotachograph.

### Prime Mover

Essentially the prime mover is a flow metering device with linear response to air flow. It is paramount in recording respiratory flow to have a primary metering element which produces energy changes which are directly proportional to flow changes. Many devices have been proposed as prime movers, but the only previous type which has met the above requirement has been the capillary tube meter of Fleisch.[1] It is essential in any prime mover to have the fundamental physiologic requirements of minimal dead space combined with linear and instantaneous recording of flow. After considerable investigation, we developed the fine mesh wire screen prime mover.[6] Research showed that 400 mesh wire screen, the finest available in commercial production, gives linear response with apparatus of a suitable size over the flow range of respiratory flows for resting, sedentary, and working human subjects. The wire screen prime mover is mounted in a small dust respirator (oral-nasal mask) frame as shown in figure 1. It consists essentially of a supported 400 mesh Monel wire screen of a diameter selected for the desired flow range or recorder sensitivity. A manifold is located behind the wire screen to average the pressure losses with varying air flows through the mesh. A pressure-measuring manifold in the unit is necessary because exhaled air is turbulent and in a considerably disturbed motion. This manifold has ten holes (0.5 mm. diameter) located uniformly around its periphery; these holes record average pressure and thus give a uniform reading regardless of the turbulence or direction of flow (inhaled or exhaled). Pressure loss varies linearly with flow, but at flows above 150 l.p.m., deviation from

1. Loc. cit.
6. Loc. cit.

linearity is about 5 per cent. (These flows are beyond the range of flows normally encountered in clinical recording.) The resistance to flow of the wire screen is below that which can be noted by any subject at low and high air flows. A resistance of 6 mm. of water is just perceptible by trained subjects. The wire used in this screen is extremely fine (0.025 mm.), hence it is obvious that the screen itself produces no dead space. The only dead space is that of the small dust respirator or anesthesia mask used in conjunction with the screen. This dead space is approximately 100-150 ml. and not of any physiologic significance.

In addition to the desirable features of linearity, negligible resistance, and minimal dead space, the fine screen provides other advantages. It is easily cleaned, and contamination of its surface is readily observed. It does not absorb moisture and is chemically inert for ordinary purposes. Monel wire is used because it has electrical resistance, and by applying electric current to terminals on each side of the screen, it is possible to increase the screen temperature and eliminate condensation of moisture on the screen. Condensation may decrease screen area if the mask is used for long periods (more than thirty minutes).

Differential recording is obtained by placing a manifold chamber on either side of the screen. The pressure difference is recorded by the recorder. This form of the apparatus is necessary for anesthesia or oxygen therapy studies where the prime mover must be placed in series with an oxygen or anesthesia supply.

The screen diameter or area is adjusted for the mask size, flow range, and desired sensitivity; thus for children a smaller mask may be used without changing the sensitivity of the recording device. In clinical work, we employ masks having screen diameters varying from ½ inch to 2 inches. All of these masks are used with a single recorder sensitivity adjustment and will produce full scale deflection at maximal air flow.

## RECORDER

The prime mover converts velocity, or air flow, of air into an instantaneous pressure. The recorder's purpose is to register this pressure instantaneously without lag or inertia on a moving photographic or recording paper. The prime mover in all cases is connected to the recorder by heavy wall small bore tubing (3 mm. inside diameter — 4½ mm. wall). The length of this tubing should not exceed 1 to 1½ m. The recording of instantaneous pressure changes may be done by several types of equipment. Two methods have been applied in our laboratory. The simplest, shown in figures 2 and 3, is a mechanical system in which a thin phosphor bronze bellows responds to the pressure changes. The bellows movements are amplified by means of a linkage connected to a rotating pivot mounted on jeweled bearings. The movements of this pivot are transmitted to a paper camera by a mirror to which a slit of light has been projected. The reflected light beam is focused on a slit perpendicular to the light beam and the movements are recorded instantaneously on moving photographic paper. Sensitivity of the bellows-linkage-camera system deflects with a pressure change of 0.05 mm. water. Different sensitivities can be obtained by adjust-

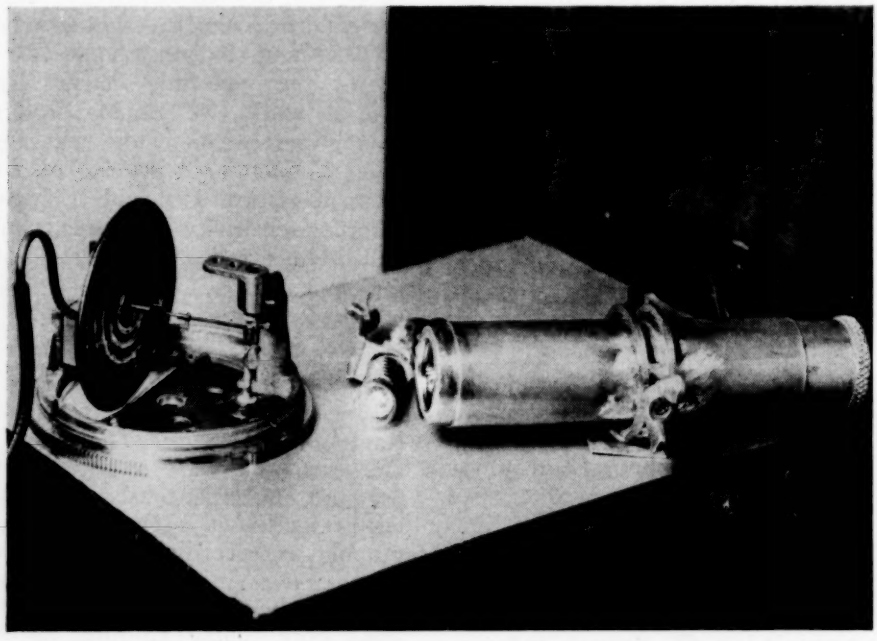

Fig. 2.—Photograph of component parts of moving paper type of recorder. Bellows unit on left. Slit light and field light for paper camera on right.

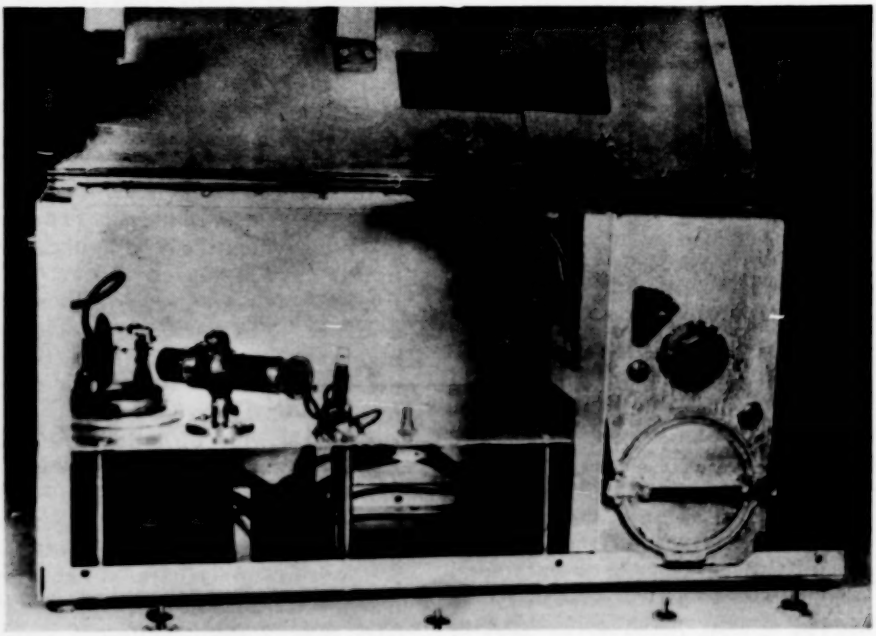

Fig. 3.—Complete photographic pneumotachograph recorder.

ment of the pivot lever length or by using phosphor bronze bellows of varying thickness. The sensitivity varies approximately with the square of the thickness.

The other method of recording applied in our laboratory makes use of a thin nickel membrane as a pressure-measuring element. The membrane deflection, however, is amplified electronically, since it is one plate of a condenser. The capacitance of the condenser, therefore, varies with the membrane movements. Pappenheimer and Lilly[8] described the use of such a device for air flow measuring and have since successfully applied our prime mover to a more sensitive capacitance manometer, as it is called, for pneumotachograph recording. The change of capacitance in their apparatus is simplified by an electronic circuit, and the output is fed into a Brush ink-writing oscillograph with minimal lag. In our laboratory, the output of the condenser amplifier (Sanborn electromanometer) is recorded on a Visocardiette (Sanborn).

All three recording methods give comparable results. The mechanical-photographic method is perhaps the simplest but requires darkroom facilities and a delay in obtaining results. The other recorders give direct reading records without further processing. It should be pointed out that electrical capacitance manometer devices are of recent development and will probably be widely used in the future. The frequency of breathing is lower than cardiac frequency, but in order to obtain a complete representation of the fluctuations involved, pneumotachograph recorders should measure changes which occur in 0.05 seconds or less.

A typical pneumotachogram is shown in figure 4. In this figure, the horizontal axis is the rate of camera feed (time intervals 1/5 second). Vertical displacements are instantaneous flows in liters per minute. The area under the curves represents inhaled and exhaled tidal volumes as indicated. Several undulations and variations in the shape of this curve can be observed; the significance of these will be pointed out below. The data which may be obtained from this curve are very useful. The gross shape characteristics of breathing are readily discernible, and frequency is obtained with the aid of timer or paper speed. Flow at any instant is obtained by measurement from a calibration. Planometric measurement of enclosed curve area yields tidal volumes or minute volume if respiration rate is taken into consideration. One can also observe from the pneumotachogram such phenomena as respiratory pauses, damping, or stenosis.

Differential recording for anesthesia and oxygen therapy is performed by connecting manifolds, on each side of the mask, to each side of the pressure-measuring recorder. The pressure element (bellows) shown in figure 2 is surrounded by a transparent chamber of equal volume. This arrangement permits differential measurements, since the pressure difference actuates the bellows. In the electrical capacitance manometer or Sanborn electromanometer, the pressures are conveyed to both sides of the thin nickel membrane resulting in a differential recording. For the differential unit, two equal lengths of the same type of pressure-transmitting tube are employed.

8. Pappenheimer, J. R., and Lilly, J. C.: Measurement of inspiratory and expiratory air velocities at altitude. C. A. M. Report No. 208, Nov. 1943.

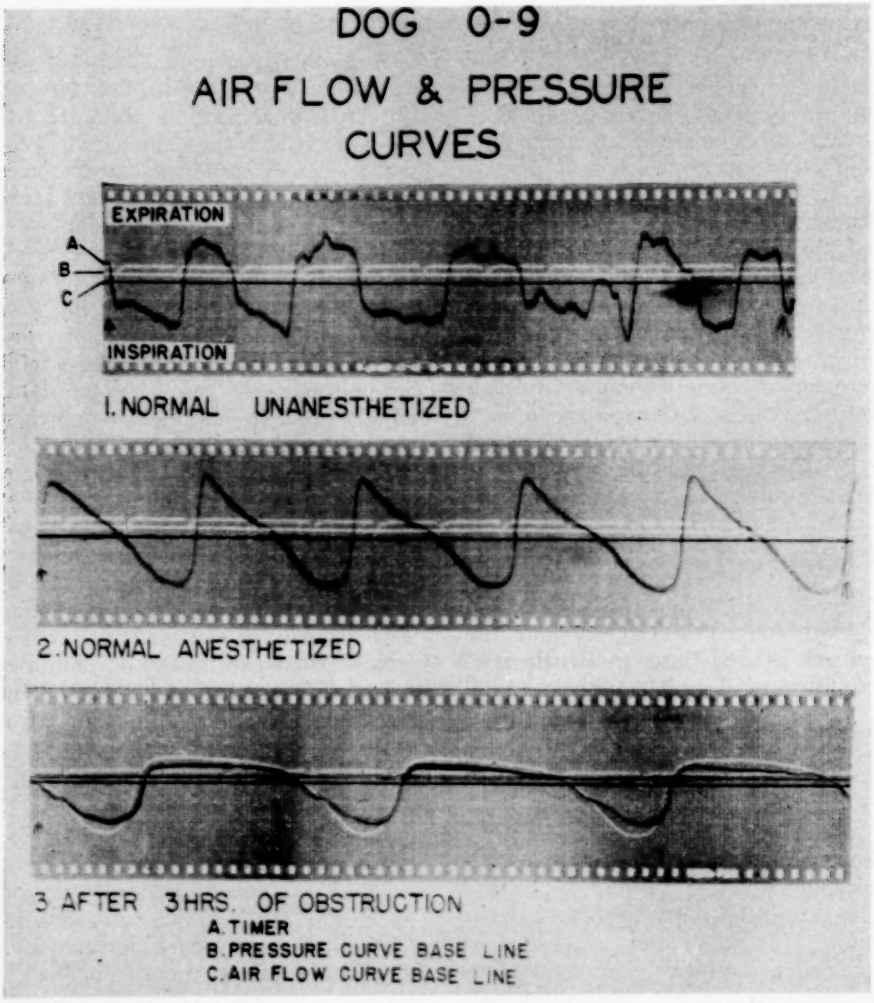


Fig. 4.—Normal and anesthesia pneumotachograms obtained on dog undergoing obstructed flow experiment.

## Calibration

The simplest and most reliable calibration of the pneumotachograph is direct flow calibration of the complete apparatus. Known air flows are passed through the screen with a rotometer, and the deflection is recorded. These deflections are plotted against the known air flows. This type of calibration will be satisfactory if the recorder pressure-measuring device is not damaged or its setting altered, and if the screen is kept dirt and lint free. In practice, the prime mover screens are cleaned at monthly intervals. A camel's hair brush is used to prevent any significant amount of dust accumulation.

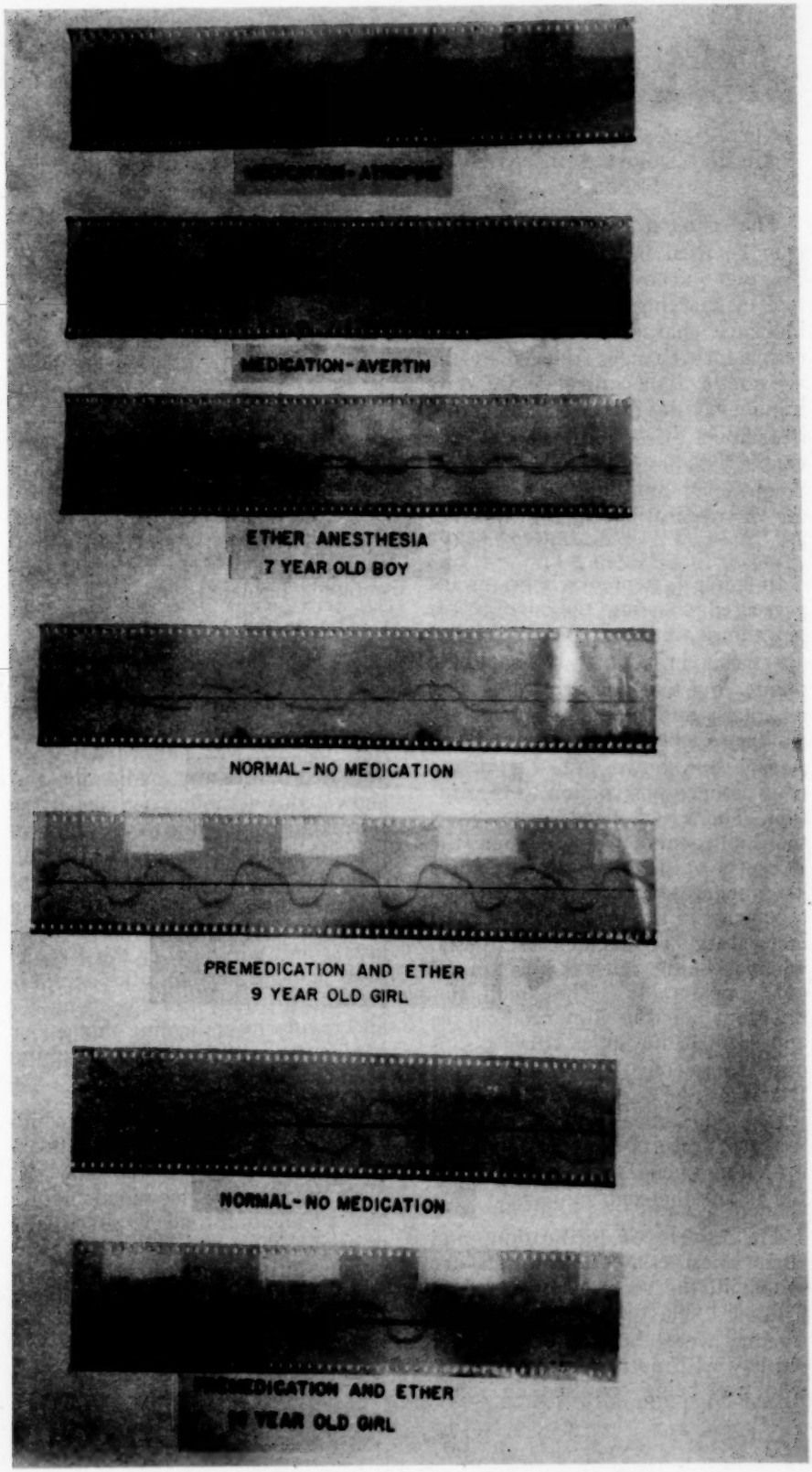


Fig. 5.—Records obtained on three young patients with medication and ether anesthesia. Expiration is shown above and inspiration below the base line.

### Application of the Pneumotachograph to Anesthesia Studies

The clinical pneumotachograph may be used in anesthesia studies for two purposes. As a research tool in studying anesthetics, it will indicate character and rate of respiratory changes induced by the anesthetic. As a control device, during anesthesia, the direct indicating instrument described above will enable the anesthetist to observe the frequency, amplitude, and character of respiration during anesthesia.

In figure 4 pneumotachograms are presented showing the changes in breathing induced by nembutal anesthesia in a dog. It should be pointed out that pneumotachograms on dogs and human beings are similar except for the differences in size. Also shown are the effects of prolonged obstruction to respiration. The anesthetized curve shows the influence of the drug on the response of the respiratory center. The inspiratory effect appears to take place in the first portion of the inspiratory cycle under anesthesia. whereas in the normal it is spread out considerably. The small undulations noted in all normal curves and seen in the upper curve disappear completely under anesthesia. It can also be observed that breathing also becomes quite mechanical with each respiration resembling the preceding one. This is not the case for unanesthetized subjects.

The effects of medication and ether anesthesia on children are shown in the records presented in figure 5. The upper set of three tracings were obtained on a 7 year old boy with no respiratory disease who was being operated on for a burn contracture of the left groin. The upper record was obtained at 9:30 a. m. after 26 mg. of atropine had been administered at 8:45 a. m. This record shows a normal respiratory tracing with the irregularities that accompany normal breathing. In the second tracing the patient is under medication with avertin. In this tracing there is a marked damping of the respiration and a very consistent regularity in shape and frequency. The third tracing with the patient under ether and medication (third stage, first plane) also shows damping and regularity, since all voluntary control of breathing and psychologic influences are absent.

The second case shown in the next two records is that of a 9 year old girl with spastic quadraplegia who was operated on for lengthening of the hamstrung muscle. The first tracing was a normal record obtained before any medication and shows considerable variation in the normal, probably due to some apprehension on the part of the patient. The second tracing on this patient was obtained after premedication (atropine, morphine, and nembutal) and while under third stage, first plane ether anesthesia. This record also shows marked damping and regularity indicating that under medication and anesthesia breathing becomes very mechanical.

The last patient presented in figure 5 was a 14 year old girl undergoing bone surgery of the hip. The first tracing was obtained before any medication and is essentially normal. The second tracing was obtained after premedication (atropine, morphine, and nembutal) and while the patient was under third stage, first plane anesthesia. The results obtained under this

(*Continued on page 69*)

# THE RELATIONSHIP OF PHYSICS TO ANESTHESIA

**Albert Faulconer, Jr., M.D.***
**Rochester, Minn.**

Some of the precepts of physics, although not immediately applicable in our daily work, enrich our understanding of the subject of anesthesiology and add to that kind of knowledge which enables us to meet new situations to the profit of our patients. It really makes little difference whether you know that the velocity of the average molecule of nitrogen in the air of this room is something like one third of a mile per second when this fact is considered alone. However, this single item of information when combined with other facts that may become known or recalled possibly can add up to a conclusion of some real practical importance in the pursuit of the daily work in anesthesia. Sir Alexander Fleming did not question the importance of recording and remembering a certain minor observation that he made while working with bacterial cultures. Rather he noted this phenomenon as an isolated bit of information, which later, when it was combined with other information derived from his researches, led to the development of penicillin. Another reason for the gathering of so-called useless information is that such knowledge increases interest in the daily work. To sit through nine innings of a baseball game in complete ignorance of any of the rules of the game must be a boring trial. However, with an intimate knowledge not only of the rules but of the personalities and records of all of the players, it can become a matter of absorbing interest. With thoughts of this type in mind, I present the subject indicated in the title of this article. Not for a moment do I pretend that I will offer anything which you may take back with you and put to practical use next week or next month, perhaps. However, I expect to leave you with just a little better understanding of some of the daily happenings under your fingers and eyes, and I hope that this improved understanding may contribute to your happiness and satisfaction in your work.

Read before the Fifteenth Annual Meeting of the American Association of Nurse Anesthetists, Atlantic City, Sept. 23, 1948.
*Section on Anesthesiology, Mayo Clinic.

## Definition of a Gas

If someone from another universe who had had no experience should ask you to define a gas, I am sure you would find it rather difficult to convey a proper impression of this state of matter. Each one of us has evolved his own understanding of what he considers a gas to be, but I would like to ask for the moment that you dismiss this concept from your mind and consider a description of this form of matter which might be derived from a modern textbook of physics.

Imagine empty space in which a vast number of minute particles are

flying about at very high speeds, and you have a rough picture of what a gas really is. Consider now in a little more detail the nature of these particles: their size, their distance apart, and how fast they are traveling. Let us consider nitrogen, a typical gas, at atmospheric pressure and normal room temperature. These particles are of such small size that, if laid side by side, several millions would be required to stretch in single file across the head of a pin. They weigh so little that 53,000,000,000,000,000,000,000 of them weigh only 1 Gm. Their average distance apart is minute at 0.00000033 cm. (1/3,000,000 cm.). Even so the relative distance apart is large when we take cognizance of the fact that this short distance is approximately 100 times the diameter of each particle. The space relationship is a little easier to visualize if it is assumed that each molecule of nitrogen is the size of a tennis ball. Under this condition the molecules would be 200 feet apart on the average. That these tiny particles are in violent activity is easily understood when we know that their average velocity at room temperature is approximately one third of a mile a second. Of course, they very seldom go as far as a mile in any one direction. They go actually very short distances before they collide with another such molecule or some bit of matter. So now we have the picture of a gas as empty space traversed by minute, widely separated particles which are traveling at extremely high rates of speed. This is the picture I would like to have you carry in your minds as I continue.

### Number of Molecules in Gases

Avogadro's law states in effect that all true gases at standard conditions, which means at a barometric pressure of 760 mm. Hg and a temperature of 0 C., will include the same number of molecules per unit volume. Stated more simply this will mean that 1 L. of oxygen at the conditions mentioned will contain exactly the same number of molecules as will 1 L. of nitrous oxide or hydrogen or nitrogen at the same conditions. Avogadro's hypothesis further states that in 22.4 L. of any gas at standard conditions the weight of the molecules present when expressed in grams will be the molecular weight of the gas. Thus hydrogen, having a molecular weight of 2, will at standard conditions weigh 2 Gm. when there are 22.4 L. of the substance present. The same volume of helium would weigh 4 Gm., of oxygen 32 Gm., of nitrous oxide 44 Gm., and so forth. Thus it can be seen that despite the fact that the number of molecules per unit volume of a gas will be the same regardless of what the gas is, the weight of the unit volume of gas will vary. By the application of Avogadro's hypothesis the molecular weight of an unknown gas may be determined from the observed weight of a measured volume of the gas.

Another constant sometimes encountered in physics is Avogadro's number which is merely a number expressing the number of molecules contained in 22.4 L. when the gas is at standard conditions. This number is 606,200,000,000,000,000,000,000.

### Pressure

All of us are familiar in our daily work with the concept of pressure in a gas, but a true understanding of this property is not always clearly held. A gas exerts pressure by virtue of the fact that it is composed of particles which have some mass

or weight and move at high velocity. Now if we imagine a sample of gas to be confined in a cube, even though the cube is small, for example 1 cc., there are literally billions of these tiny particles hammering at the walls every second, and these particles are moving with an average velocity of something like one third of a mile a second (fig. 1). Even so tiny a bit of matter as a gas molecule moving at that velocity imparts a push against the wall when it encounters this obstruction. When this push is multiplied several billion times each second, the resulting force is easily measurable. This measured force is called pressure. If to the gas in our small cube we add another equal number of molecules of gas, which would be another cubic centimeter at the same conditions of temperature and pressure, it is seen from the description I have already made that there is still plenty of room

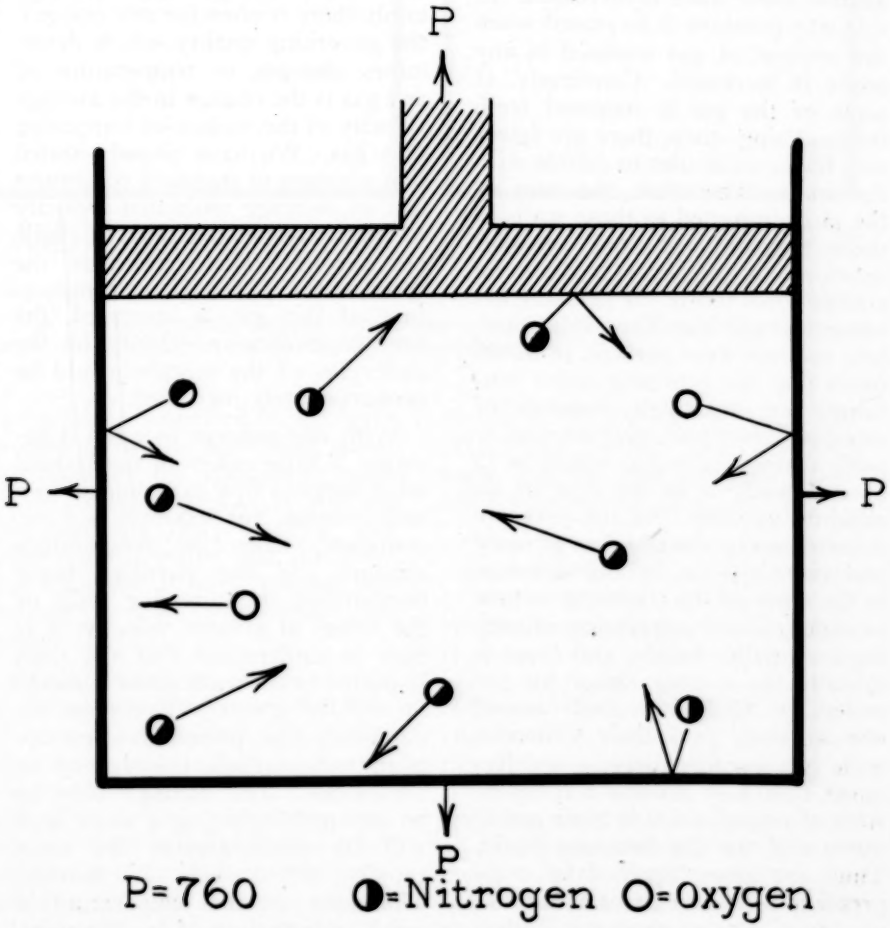


Fig. 1.—Air confined in a chamber showing that pressure is a result of molecular bombardment of the chamber walls.

for these molecules, there being something like 100 times the diameter of each particle between particles. At first glance, it seems that there should be room enough to pile many cubic centimeters of this gas into our small container before crowding occurs. However, with each addition of many billions of the gas molecules, the number of collisions against the confining walls that these molecules make is increased, and thus the total push against these walls is increased. In this way pressure is increased when the amount of gas confined in any space is increased. Conversely, if some of the gas is removed from the confining space, there are fewer and fewer molecules to collide with the walls. Therefore, the sum of the push imparted to those walls in their frequent collisions becomes smaller and smaller. Or, in more conventional terms, the pressure becomes less and less. Thus, if an absolute vacuum were present, it would mean that the confining space contained not one single molecule of any gas. Therefore, the pressure, or push against the walls, would be O as it actually is in the case of an absolute vacuum. As the pressure is increased by the addition of more and more gas or by the decrease in the space of the confining volume as under piston compression, crowding eventually obtains, and there is actually not enough space for the molecules to fly around among one another, and their collisions with one another become so frequent that they assume a different state of organization in their movement, and the gas becomes liquid. Thus are gases liquefied by compression. On this information we may base a more thorough understanding of Boyle's law, which states in effect that if the temperature is kept constant, the pressure of a gas increases as the volume decreases, or in more mathematical terms the volume of a gas is inversely proportional to its pressure.

**Effect of Temperature.** — Now let us consider the temperature of a gas. Just what is it about a gas that makes it hot or cold? The temperature of a gas is entirely the physical expression of the energy of the moving particles of the gas. Therefore, if there is no change in the mass of the particles, and certainly there is none for any one gas, the governing quality which determines changes in temperature of any gas is the change in the average velocity of the molecules composing that gas. We have already stated that nitrogen at standard conditions has an average molecular velocity of approximately one third of a mile per second. This represents the speed at 0 C. Now if the temperature of this gas is increased, the average molecular velocity of the molecules of the sample would be proportionately increased.

With this concept in mind it becomes a little easier to understand what happens to a gas confined in a unit volume, for example a 1 cc. container, when the temperature changes. If the particles begin bombarding the confining walls of the vessel at greater velocity, it is easy to understand that the push imparted to the walls when summed up will be greater. Everyone understands this principle when applied to a particle the size of an automobile. The damage done by an automobile hitting a stone wall will be much greater the more rapidly the vehicle is moving. Therefore, as the temperature in our 1 cc. container of gas increases, the pressure increases, because pressure is merely a measure of the sum

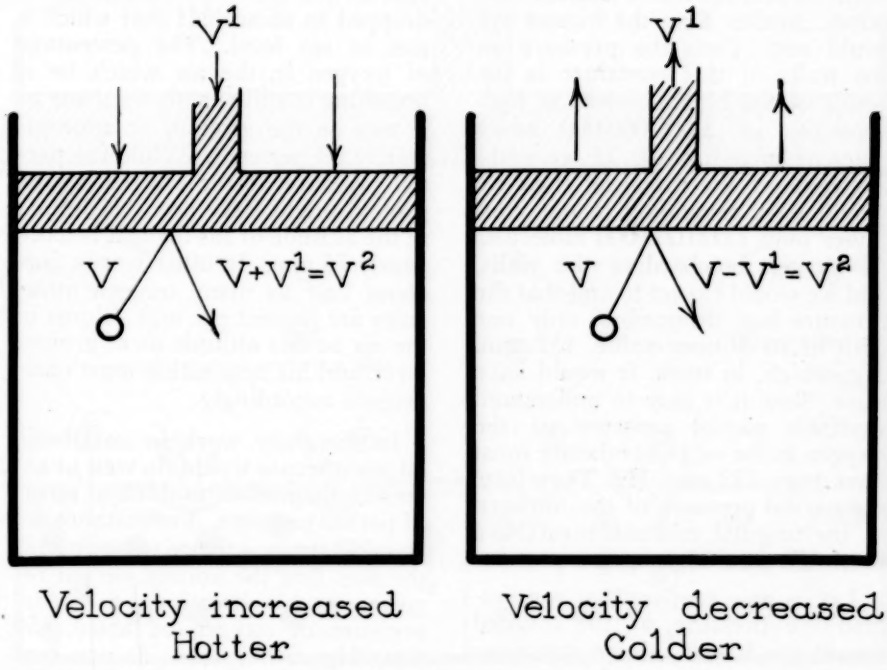


Fig. 2.—Temperature changes with changes in molecular velocity. Thus heating occurs with compression and cooling with decompression.

of the pushes imparted by the bombardments of the individual molecules against the containing walls of the vessel (fig. 2). It is from this concept that Charles' law comes, which states that the pressure of a gas at fixed volume will increase as the temperature increases (fig. 2).

**Partial Pressure.**—Dalton's law of partial pressures states that in a mixture of gases each gas exerts its own pressure and acts as though it were alone in the containing volume. This is a very important concept, for from it we come to understand what is meant by partial pressure of a gas and all that is implied by this term. Let us consider air as a typical gas mixture and assume that it is composed as it is approximately of 80 per cent nitrogen and 20 per cent oxygen. In other words there will be four nitrogen molecules for every oxygen molecule.

Now let us assume that we have captured a minute sample of air in a tiny container where we can watch the pressure. We find that if we are at sea level the pressure of the air in this small container is 760 mm. Hg. Referring to our discussion of pressure, we know that this 760 mm. Hg is a measure of the push on the walls of the vessel resulting from the bombardment of all of the gas molecules in the confining volume. Let us further assume that our container is small enough that there are exactly 4,000,000,000 molecules of nitrogen and 1,000,000,000 molecules of oxygen

which would indeed be a small container, smaller than the human eye could see. Thus the pressure on the walls of this container is the result of the bombardment at high velocities of 5,000,000,000 molecules of mixed gases. If we withdrew all of the nitrogen, then we would have remaining in our container only 1,000,000,000 molecules of oxygen bombarding the walls, and we would expect to find that the pressure had dropped to only one fifth of its former value, 152 mm. Hg, which, in truth, it would have done. Now it is easy to understand that the partial pressure of the oxygen in the original mixture must have been 152 mm. Hg. Therefore, the partial pressure of the nitrogen in the original mixture must have been 608 mm. Hg.

Let us now suppose that we doubled the pressure of the original mixed gas in our minute container by adding another equal volume of air. Now the pressure instead of being 760 mm. Hg is 1,520 mm. Hg. The percentage of oxygen present remains the same, 20 per cent. However, the partial pressure of the oxygen present now becomes one fifth of 1,520 mm. Hg, or 304 mm. This fact seems entirely logical when we remember that now there are 2,000,000,000 molecules of oxygen bombarding the walls of the container, whereas before there were half as many. Thus the use of the term "partial pressure" becomes a much more accurate method of referring to the actual number of molecules or amount of a gas present in any volume of a gas mixture.

A classic example is the valuable use of the concept of partial pressures in some of the physiologic problems in aviation. As an aviator flies at 18,500 feet the total pressure of the air he is breathing has dropped to about half that which it was at sea level. The percentage of oxygen in the air which he is breathing is still exactly the same as it was on the ground, or approximately 20 per cent. While the partial pressure of the oxygen on the ground might have been 152 mm., at the altitude of his flight it is more nearly 75 mm. In other words, just about half as many oxygen molecules are present per unit volume in the air at this altitude as at ground level, and his respiration must compensate accordingly.

In the daily work in anesthesia all anesthetists would do well to accustom themselves to think in terms of partial pressure. For instance we should keep as a figure in our minds the fact that the normal person requires in his breathing a partial pressure of oxygen of about 150 mm. Hg rather than 20 per cent oxygen. When we consider the amount of ether vapor required for anesthesia, instead of saying something between 3 and 6 per cent, let us refer to a partial pressure of 25 to 50 mm. Hg. The amount of nitrous oxide required to produce anesthesia instead of being 80 to 90 per cent might be considered as a partial pressure of 600 mm. Hg. If we do this, we will have a much more accurate idea of dosage of these gases than is possible when we think of them in terms of "per cent."

## Solubility of Gases

Henry's law is the law governing the solubility of gases in liquids. Let us turn again to our concept of a gas as a family of high velocity, minute particles, and here let us place in containing vessels some liquids, such as blood and oil. It is widely recognized that the ability of

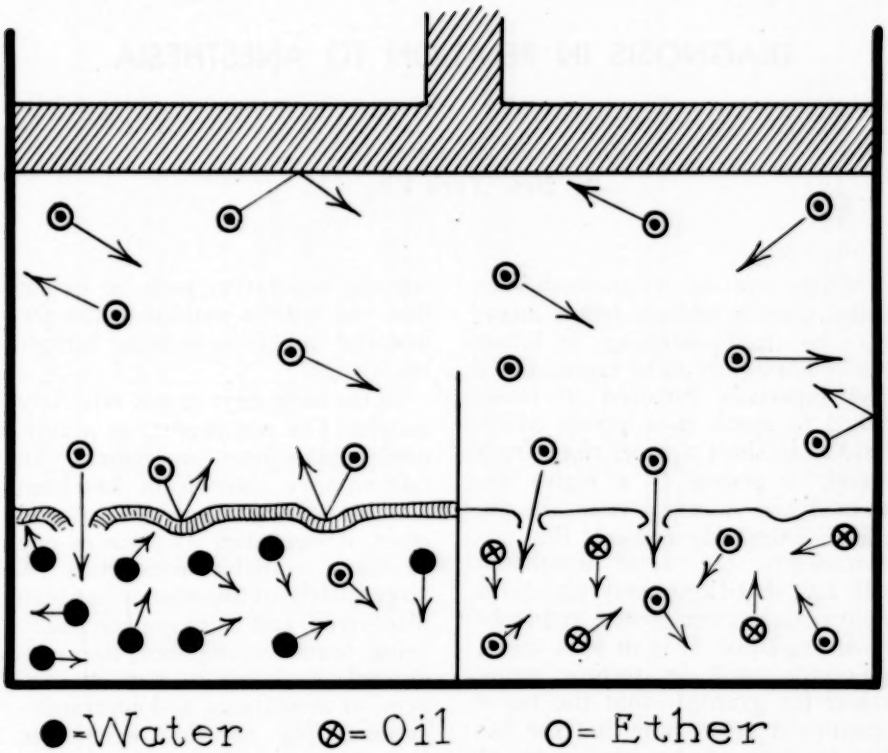


Fig. 3.—Difference in solubility is indicated by relative thickness of surfaces. Amount of vapor dissolved depends also on the partial pressure of the vapor (number of molecules per unit volume).

these two liquids to dissolve various substances differs, and these differences apply equally well to gases. As in the accompanying illustration (fig. 3), let us think of the liquid which has the lower solubility for the gas under consideration, for example, ether vapor, as presenting a barrier to the intrusion of the molecules of this vapor, while the liquid having the higher solubility, oil, has a very easily broken barrier against this intrusion. If the liquid surface forms a portion of one wall of the containing vessel, as it often does or certainly as we may think of it, then this barrier, wall, or liquid surface, is bombarded just as the confining walls of the vessel are and receives its share of the pressure or partial pressure of the gas attempting to enter the liquid. Now it is apparent that the number of molecules breaking through the barrier will be proportional to the number of molecules present in the gas. In Henry's law this is expressed as the fact that the amount of any gas or vapor dissolved in a liquid is proportional to the partial pressure of the gas. Henry's law further states that the amount of any vapor or gas dissolved in a liquid is proportional to its solubility in that particular liquid. This solubility factor is represented in figure 3 as the thickness of the bar-

(*Continued on page* 82)

# DIAGNOSIS IN RELATION TO ANESTHESIA

Raymond W. Sass, M.D.*
New York City

When one of a profession is called upon to address fellow members of that profession, it is an honor not lightly to be taken, and I feel especially honored in being asked to speak to a group which has, in so short a time, risen from merely a protest to a highly esteemed and essential entity in the ranks of the body medical. But, unfortunately, the nurse anesthetist still has, in all too many places, to fight senseless antagonism and stubborn prejudice. It is in such cases, especially—skill in technic being taken for granted—that the nurse anesthetist must show that she has the background knowledge to go with her pragmatic skills.

What is the effect of this anesthetic? Can we use this anesthetic for Mrs. S. who has hypertension? Is this a *safe* anesthetic? Do you know what to do if signs of collapse occur? Do you ***know*** the signs of impending cardiac or respiratory collapse? Such queries as these, especially in small communities, the nurse anesthetist must be prepared to answer, and so earn a place in the medical hierarchy of the community.

I shall attempt to outline for you the answer to some of these frequently recurring problems. I shall present nothing new and nothing original, but I shall try to systematize the subject to such an extent that you will be enabled to use the material as a basis for further knowledge.

In the early days it was relatively simple. The anesthetist, as a rule, used chloroform or ether. In this country chloroform has been almost entirely discarded. As to ether, it has taken its place as one of many available anesthetics. A large variety of anesthetics has been discovered, and more are constantly being found, synthesized, and synergized. Each has its uses, its dangers, its indications, and contraindications. No *one* has ever been brought forward that is entirely safe, entirely nontoxic, and entirely foolproof, although it remains true today, as it has for so long, that semi-open drop ether is the safest in inexperienced hands.

Before going into detail as to what conditions indicate or contraindicate what anesthetics, we should know the types of anesthesia and the specific agents that are available. With this data as a background, we can correlate the modality with the condition, anatomy, and diagnosis. Table 1 lists the types of anesthesia, the specific agents, and their mode of application.

As qualified anesthetists who have pursued postgraduate studies in anesthesia, you are doubtless familiar with the pharmacology and the physiologic effects of the drugs mentioned. Their chemistry is, to us, unimportant. In order to be

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*Post-Graduate Hospital; New York City Department of Correction Hospitals.

TABLE 1.—TYPE OF ANESTHESIA, AGENT, ROUTE OF ADMINISTRATION

| TYPE OF ANESTHESIA | AGENTS | ROUTE OF ADMINISTRATION |
|---|---|---|
| Topical | Cocaine<br>Nupercaine<br>Ethyl chloride (spray)<br>Hematropin<br>Butyn | Direct application of solution, ointment, paste, etc., to local area of skin or mucous membrane. |
| Block | Pontocaine<br>Procaine<br>Metycaine<br>Quinine-urea hydrochloride<br>Eucupin | Injection of anesthetic solution.<br>1. Infiltration—local anesthesia of tissue itself.<br>2. Field block—anesthetic solution injected to surround the area.<br>3. Nerve block (spinal, caudal, sacral, brachial plexus block)—anesthetic solution injected to surround and bathe the nerve, ganglion, or plexus supplying the part. |
| Intravenous | Sodium amytal<br>Pentobarbital sodium<br>Morphine sulfate<br>Evipal soluble<br>Pentothal sodium | Introduction into the circulatory system through a vein of a hypnotic, sedative, or anesthetic drug. |
| Inhalation | *Volatile substances*:<br>Ether<br>Vinethene<br>Chloroform<br>Ethyl chloride<br>Trichlorethylene<br>*Gaseous substances*:<br>Nitrous oxide<br>Ethylene<br>Cyclopropane | Inhalation of a vapor or gas. (Intratracheal anesthesia is a modification of the inhalation method.) |
| Rectal | Ether and olive oil<br>Avertin (with or without amylene hydrate)<br>Trichlorethanol<br>Chloral hydrate<br>Paraldehyde<br>Sodium salts of various barbiturates | Instillation of anesthetic mixture or substance into the rectum. |
| Hypnotism | | (Obstetric procedures as well as major and minor operations have been performed on susceptible subjects. In India its use in major surgery is not infrequent.) |

able to decide whether or not a certain anesthetic should be used for a certain patient, you must know its action, not only as an anesthetic, but on the body as a whole and on the body systems (circulatory, respiratory, central nervous, urinary, etc.).

If in the hospital in which you have established yourself as a competent and trustworthy anesthetist, a surgeon says to you, "At 9 a. m. tomorrow morning I'm going to repair a left inguinal hernia in a 65 year old man who has diabetes and mitral stenosis and who is rather debilitated. I'd like to do the operation under spinal anesthesia, but if you think not, I'll leave the choice of anesthetic to you," you must have good physiologic and pharmacologic reasons for the choice you make. You must know, for instance, that for the debilitated patient with cardiac disease spinal anesthesia is liable to be an unfortunate choice, and you should know why. And you must know that nitrous oxide, because of the anoxemia it creates, causes a rise in blood pressure, and that morphine depresses respiration.

You can easily look up any of these substances in a standard pharmacopeia or textbook of physiology and learn its pharmacologic and physiologic effects. If you plan to be a *good* anesthetist, you will do so, and you will keep rereading until you are thoroughly familiar and at home with the knowledge. Although such discussion is beyond the scope of this article, there are certain broad actions of these drugs, the "finger tip" knowledge of which will make for choice or rejection in certain types of cases and in certain diagnoses. Among the conditions which you will most frequently encounter and for which you should be prepared are hypertension, diabetes, kidney disease, tuberculosis, heart disease, brain tumor, and so forth.

While it is true that the well informed anesthetist will be familiar with *all* types and technics of anesthesia, the fact remains that the nurse anesthetist will almost exclusively confine her activities to general anesthesia, i.e., inhalation and rectal. The medical and medicolegal aspects of spinal anesthesia, field block anesthesia, and intravenous anesthesia are not, to my knowledge, completely ironed out, although I believe that a nurse can be trained to do these procedures fully as well as can an embryo doctor. I quote from *Surgery, Gynecology and Obstetrics* for June 1948:

> The American College of Surgeons is of the opinion that . . . in view of the splendid record of achievement of the nurse anesthetists, institutions engaged in the training of nurses for this purpose should be encouraged to continue their programs. . . . Nurse anesthetists who have specialized in the administration of anesthetics are usually competent and acceptable for the work, but since they are not physicians licensed to administer drugs they should be under medical supervision.

This would seem to indicate that before long more nurse anesthetists will be administering *all* types of anesthetics. However, since it is, unfortunately, a goal of the future, we need not concern ourselves at this time with topical, injection, and intravenous anesthesia. Table 2 lists the agents used for general anesthesia, inhalation and rectal, and their good and bad points.

Two factors that must be considered in making a choice of anesthetic are the cost or availability of the drug and the site of the operative procedure, that is, the anatomy involved.

The availability of the agent is a factor that is frequently overlooked

TABLE 2.—GENERAL ANESTHETIC AGENTS: GOOD AND BAD POINTS

| AGENT | GOOD POINTS | BAD POINTS |
|---|---|---|
| Ether | Wide margin of safety between good anesthesia and cardiorespiratory danger.<br>Excellent relaxation.<br>One of safest and best anesthetics for patients with severe cardiac disease.<br>Excellent results in combination with many other inhalation anesthetics. | Highly inflammable.<br>Induction generally difficult.<br>May cause laryngospasm, tracheobronchial irritation, or reflex cessation of respiration.<br>Nausea and vomiting.<br>Contraindicated, as a general rule, in kidney disease, uncontrolled diabetes, pulmonary tuberculosis, and brain tumors with convulsive symptoms. |
| Vinethene | Excellent for short procedures. | Prolonged use may cause liver and kidney damage. |
| Chloroform | None—in this country. | Very narrow margin of safety.<br>May cause liver damage.<br>Must not be used with adrenalin. |
| Ethyl chloride | Very easy induction. | Narrow margin of safety.<br>Poor relaxation.<br>Highly explosive. |
| Trichlorethylene | Good for short procedures. | Danger of respiratory depression. |
| Nitrous oxide | Wide margin of safety.<br>Generally excellent in combination with ether and oxygen.<br>Excellent with oxygen for short procedures. | Safe only when used in combination with oxygen.<br>Poor relaxation unless used with ether.<br>Induction may be difficult.<br>Danger of anoxemia of central nervous system.<br>Contraindicated in hypertension. |
| Ethylene | Wide margin of safety.<br>Excellent in shock and hypertension.<br>Excellent combined with ether and oxygen.<br>Good for patients with cardiac disease.<br>Well tolerated by most patients. | Highly explosive.<br>Poor relaxation.<br>Increases capillary bleeding during operation. |
| Cyclopropane | Wide margin of safety.<br>Easy induction.<br>Good relaxation.<br>Tolerated well by most patients.<br>Good for patients with cardiac disease. | Highly explosive.<br>May cause laryngospasm.<br>May cause cardiac fibrillation. |
| Rectal anesthetics | Generally safe.<br>Provides good basal anesthesia.<br>Ideal for patients with hyperthyroidism and markedly nervous patients. | Contraindicated in presence of lesions of rectum and colon. |

in a discussion such as this, but it is of great importance. You may find yourself associated with a small hospital with a budget that will not allow of a great variety of anesthetics or specialized equipment from which to choose. Here your judgment will be especially tried since, with a limited choice, you must weigh all the factors involved very carefully in order to make the best use of the drugs available. During World War II, I was chief of a gynecology service and also chief of a surgical service in station hospitals where neither qualified anesthetists nor a great variety of anesthetics were available. The lack of a variety of anesthetics was not due to economy but to scarcity and Army policy. I had to relearn the subject matter discussed in this article and select the anesthetic to be used, myself. We had to give our own spinal and caudal anesthetics, as well as other types of regional and injection anesthesia, although the officers on the medical service would give the general anesthetics for us. We had to make do whatever anesthetic agents were made available to us by higher echelon, and we learned to choose the one we thought came nearest to what we would have preferred under other circumstances. Accordingly, this factor is one to be reckoned with.

As to the anatomic location of the operative procedure, specific factors dictating the choice of anesthetic, in addition to general ones, include:

Convenience of administration
Estimated duration of operation
Relative risk of anesthesia and operation
Position of patient during operation
Presence of infection
Spatial relation of area to equipment used in giving anesthetic

To illustrate, you would hardly give a general anesthetic to take off a wart, you would not give a spinal anesthetic through an area on the back covered with infected sores, and you could not very well use a face mask for a submucous resection of the septum. Table 3 lists the type of anesthesia preferred for operations in various anatomic regions.

Many of you work in hospitals where injection anesthesia is not commonly used. Unfortunately too many doctors are still general-anesthesia minded and refuse to use injection methods. There is, to my mind, no question of the fact that there is less risk involved in injection anesthesia as compared with even the safest and the best methods of general anesthesia. A conscious patient is a better risk than an unconscious one. Injection anesthesia is here to stay, and eventually the pendulum will swing toward a higher percentage of cases done under that type of anesthesia than under general anesthesia. I perform 90 per cent of my operative procedures (abdominal and pelvic surgery), including cesarean section, under injection anesthesia. However, this does not mean that there will not be plenty of work for many years to come for those who are skilled in administering general anesthetics.

Balanced anesthesia, the combination of two or more anesthetic methods or two or more anesthetic agents, such as good preoperative medication combined with a small amount of inhalation anesthetic plus injection anesthesia, is always good except for operations of such local character and of such short duration that the preparation required is not worth it. The chloroform mixtures, as used in Europe, do not

## TABLE 3.—PREFERRED ANESTHESIA FOR OPERATIONS IN VARIOUS ANATOMIC REGIONS

| REGION | PREFERRED ANESTHESIA |
|---|---|
| *Head* | Practically all operations on patients in good condition may be done under topical, injection, inhalation, rectal, or balanced anesthesia; topical or injection is preferred. |
| Eye | Topical preferred. |
| Cheek | Injection or intratracheal inhalation. |
| Ear | Drop ether or balanced anesthesia. |
| Tongue | Explosive inhalation agents contraindicated since cautery is often used. |
| Tonsils | Adults—always injection, if possible.<br>Children—always inhalation. |
| Peritonsillar abscess and phlegmon | Injection if possible; if not, intratracheal inhalation must be used. |
| *Neck* | |
| Respiratory system | Injection or intravenous. |
| Esophagus | Never general anesthesia; reflexes must be present. |
| Neck glands; phrenectomy | Injection. |
| Thyroidectomy | Injection plus nitrous oxide-oxygen. |
| *Thorax* | |
| Breast | General anesthesia for amputations. |
| Aspiration of fluid | Injection. |
| Pericardectomy | Injection. |
| Thoracoplasty | Spinal, in the presence of productive cough; general, cyclopropane preferred, in the absence of cough or when secretions can be drained posturally. |
| Bladder, prostate, and ureter | Injection. If inhalation is used, ether should not be used in presence of kidney disease. |
| *Abdomen* | Except as indicated, all methods are good. Injection is preferred. For perforating abdominal wounds, an intratracheal tube must be used if inhalation anesthesia is used. Cyclopropane is ideal for cases of shock. |
| Gallbladder | Ether provides needed relaxation. |
| Spleen | Ether is preferred because it causes spleen to empty. Spinal contraindicated because of possibility of hemorrhage. |
| Gynecologic procedures | Injection preferred. |
| Spinal column and nerves | General anesthesia is preferred because of medicolegal problems that may arise. |
| Peripheral nerves | Injection. |
| Kidneys | Spinal preferred, except in debilitated patients; do not use ether. |
| Perineal region, anus, penis, vulva | Injection. |
| Extremities | Injection preferred, except for major procedures on the arm when a general anesthetic must be used. |

come under the heading of balanced anesthesia. If for some reason injection anesthesia is rejected for those anatomic situations mentioned, balanced anesthesia may well be used. And for almost all debilitated patients balanced anesthesia will be found better than any other method. This is another reason why the anesthetist giving general anesthetics will never be entirely replaced.

We now come to the crux of this discussion, that is, the specific "do's" and "don't's" in planning the anesthesia for various disease entities and conditions. Just as it requires twenty-four hours' preparation for an operation that may take only twenty minutes, so it requires a knowledge of all the background material that has been covered for a brief résumé of the relationships of diagnosis to anesthesia.

The very young and the very old require special attention. It should be emphasized that considerations which apply to the very old apply in general to the middle-aged group when debility is present, because it is, in the main, the debility of the very old which makes them a problem. The very old patient generally requires less potent anesthetics and less of them. Pentothal sodium and nitrous oxide-oxygen are among the best. For spinal anesthesia much smaller amounts of the agent are needed.

Because the very young patient is prone to emesis, apparatus for aspiration must be ready *before* the anesthesia is begun. Avertin is well tolerated.

Many patients are drug sensitive, both to the anesthetic drug used in injection anesthesia and to adrenalin and even ephedrine. Sometimes cobefrin is of value. When a vasoconstrictor cannot be used at all, it may require a change in the method of anesthesia used. Nitrous oxide and ethylene may be used in almost all cases of drug allergy, as may the barbiturates and avertin in small doses. Here is an ideal field for balanced anesthesia. *Always* question *every* patient about sensitivity or previous difficulty with agents whose use is contemplated.

At altitudes one mile or more above sea level, lessened oxygen availability is a factor, and the use of nitrous oxide is dangerous. Injection anesthesia or inhalation anesthesia with increased oxygen may be used. Weather is also a factor. In cold and rainy weather, especially for those patients who complain of difficulty in breathing in such weather, spinal anesthesia is preferred. If inhalation anesthesia must be used, ether with a rich supply of oxygen or balanced anesthesia is indicated. With spinal anesthesia the incidence of pulmonary complications is decreased. In hot weather either spinal anesthesia or inhalation anesthesia with adequate oxygen should be used. In the presence of a very high body temperature, ether should not be used since it may cause increased intracranial pressure and depression of respiration.

Because of explosion hazards with inhalation anesthetics, injection anesthesia is best when the cautery is to be used.

Table 4 lists the disease entities and conditions commonly encountered and the preferred methods. Needless to say, there are many other conditions, not so frequently encountered, which require special consideration when they arise. Consultation among the anesthetist, the surgeon, and the internist is of inestimable value in determining the best procedure for the patient.

TABLE 4.—PREFERRED ANESTHESIA FOR VARIOUS DISEASE ENTITIES

| DISEASE ENTITY | PREFERRED ANESTHESIA |
|---|---|
| Epilepsy | Intravenous anesthesia or barbiturates rectally are ideal. |
| Hyperthyroidism | Intravenous anesthesia preferred. |
| Drug addiction | Spinal is preferred. If inhalation is used, an intratracheal tube is used. |
| Heart disease | Ethylene and cyclopropane with plenty of oxygen; quick induction, early intubation important. Spinal is good. |
| Hypertension | Spinal or intravenous is good. Nitrous oxide should be avoided. |
| Hypotension | Nitrous oxide-oxygen or balanced anesthesia is good. Spinal anesthesia should be avoided. |
| Angina pectoris | Inhalation with intratracheal tube with plenty of oxygen. |
| Cerebral accident | Spinal is good. Vasoconstrictors and nitrous oxide should not be used. Balanced anesthesia is good. |
| Anemia | Barbiturates cause spleen to take up red blood cells and should not be used. Plenty of oxygen should be given. (Patients generally debilitated.) Spinal anesthesia should not be used in pernicious anemia. |
| Obesity | Intravenous anesthesia is difficult. Spinal is good. If inhalation is used, intratracheal tube should be used. |
| Skin infections | All injection methods should be avoided. Nasal furuncle contraindicates inhalation anesthesia. |
| Central nervous system diseases, or spinal deformity | Spinal should be avoided because of medicolegal complications. |
| Diabetes | Uncontrolled diabetes is always bad surgical risk. Ether should be avoided. Spinal is good. In controlled diabetes any method, including ether, is satisfactory. |
| Kidney disease | Spinal or gas; ether should be avoided. |
| Anuria or uremia | Spinal; the patient must not be rendered unconscious by the anesthetic. |
| Urinary tract infection | Small dose of spinal anesthetic, or balanced anesthesia. Ether should not be used. |
| *Respiratory tract* | |
| Tuberculosis, bronchitis, bronchiectasis | Local. Do not use intravenous. |
| Pneumonia | Spinal is best. Gas with plenty of oxygen may be used. |
| Empyema | Intravenous for adults. Injection or gas with intratracheal intubation for children. |
| Upper respiratory tract infections | Spinal. Avertin should not be used. |
| *Alcoholism* | |
| Acute | Ether is satisfactory; the stomach should be emptied. |
| Chronic | Injection is best. Patients are resistant to ether. |
| Hysteria | General is best, any method. Spinal should be avoided. |
| Pregnancy | These patients tolerate any method. |
| Liver disease | Intravenous pentothal sodium anesthesia preferred except in the presence of severe liver damage when inhalants with oxygen should be used. |
| Exanthems: measles, scarlet fever, chicken pox | Any method which has a tendency to produce pulmonary complications, to which these patients are particularly susceptible, should be avoided. |

Proper premedication is as important as the proper choice of method of anesthesia; this is most brilliantly demonstrated in the "stealing" operation used in hyperthyroidism. Usually the patient's surgeon will decide upon the preoperative medication. However, it is often left in the hands of the anesthetist, who must therefore be as familiar with premedication drugs as with anesthetic agents. You will note that nowhere have I touched upon technic. Excellence in technic is taken for granted in a group composed of persons who have undergone as much training as all of you have. However, it should never be forgotten that meticulous attention to details of technic is often just as important in the success or failure with a given agent as the agent itself.

Summary

A thorough basic knowledge of the pharmacology and physiologic action of the anesthetic agents is essential to their proper use. In planning the anesthesia for the individual patient, the possibility of allergy and the effects of debility must always be kept in mind. Balanced anesthesia is an invaluable method in many cases.

No one is infallible. No one is expected to be infallible. But I want you always, in case of an untoward incident happening on the operating table or postoperatively to be able, because of your preparation, to examine the choice of anesthetic and the technic of its administration and say to your medical conscience, "I have done my best."

My Gift

**To the Agatha Hodgins Educational *Loan* Fund**

**I hereby donate $_____to the Agatha Hodgins Educational Fund, which is "designed to extend financial assistance to graduate nurse anesthetists in obtaining further education and training to become qualified instructors, or to instructors who desire and need additional training to become better qualified."**

**Name**_____

**Address**_____

_____

**(Checks should be made payable to: American Association of Nurse Anesthetists, for Educational Fund, and sent to: American Association of Nurse Anesthetists, 22 E. Division St., Chicago 10, Illinois.)**

# THE PATIENT MUST CONSENT

Emanuel Hayt, LL.B.*
New York City

Consent for the use of anesthetics does not follow as a matter of course when the patient submits to surgery. The surgeon or the hospital should obtain a consent not only to operate but to use "any anesthetics." That such policy is desirable is demonstrated by a recent case.

The mother-in-law of the patient stated that, prior to the operation, she told the doctor to use no spinal anesthetic; the husband of the patient testified likewise. This was denied by the doctor; he asserted the spinal anesthetic was to aid in the removal of a piece of hypodermic needle lodged in her left thigh; that it would have been inadvisable to use a general anesthetic because the operation was to be performed under the fluoroscope in the x-ray room; that there is danger of explosion in using inflammable general anesthetics in a room where electrical equipment such as x-ray is being used; also that it was inadvisable to give a general anesthetic since the patient had been recently operated on for appendicitis, and such anesthetics may produce nausea and vomiting, which would cause distention of a fresh wound. Novocain injected locally could not be used either, because the quantity required would have so affected the tissues as to produce sloughing in the field of operation.

Since the authorization for operation procured by the hospital included a consent for the use of "any anesthetics," and as there was no proof of damage from the use of the spinal anesthetic, the complaint was dismissed.[1]

## LIABILITY FOR UNAUTHORIZED OPERATIONS

It is an established principle of law that every human being of adult years and sound mind has the right to determine what shall be done with his own body; therefore, when a surgeon performs an operation without his patient's consent, he commits an assault for which he is liable in damages, except in cases of emergency where the patient is unconscious, and where it is necessary to operate before consent can be obtained.[2]

This principle is illustrated in a case in which a patient consented to an operation upon her right ear. During the operation the condition of the left ear was found to be more serious because there was a small perforation high up in the drum membrane, with granulated edges; the bone of the middle ear wall was necrosed. The operating surgeon called the attention of the family physician to this condition; they both agreed that it would be desirable to operate upon the left ear instead of the right. A skilful and successful ossiculectomy was performed on the left ear.

Suit was brought against the surgeon for damages based on impaired hearing which she attributed

*Counsel for A.A.N.A.

1. Kester v. O'Neil, 138 P. 2d 723, 59 Cal. App. 2d 428.
2. Schloendorff v. The Society of the New York Hospital, 211 N. Y. 125, 105 N. E. 92.

to the operation. The court held that there was a technical assault. While the surgeon during the patient's unconsciousnes is justified in operating without the latter's consent, an emergency must be shown to have existed. In the court's opinion, the condition of the left ear drum did not endanger the patient's life or health, and no emergency was present which excused an operation without the patient's authorization.[3]

Whether an emergency in fact exists under particular circumstances is a question for the jury. For example, a jury was held to be justified in finding that the removal of a sesamoid bone from the foot of a patient was not an emergent condition, where the proof indicated that the procedure was not a major operation.

In that case the operation as originally contemplated proposed the making of an incision in the foot to drain the joint and remove any foreign matter due to an inflammation. The patient had stepped on a nail which penetrated the great toe of the right foot; the wound failed to heal some sixty days after the injury.

The physician attempted to prove that the removal of the sesamoid bone was in the nature of an emergency, but the jury found otherwise. On appeal, the jury was upheld. The court stated that ordinarily if, in the course of an operation, the physician discovers conditions not anticipated and which, if not removed, would endanger the life or health of the patient, he would, though no express consent was obtained, be justified in extending the operation to overcome them; reasonable latitude will be allowed to the physician for the welfare of the patient.[4]

After consulting and engaging a physician for an operation, a patient entered the hospital. She was operated upon the next day; the physician attempted curettage, but the operation developed into a vaginal hysterectomy. During the first nine days after the operation, the patient was in a normal postoperative condition. After this period a high fever developed, her abdomen became sore, distended, and discolored, and her entire skin changed color. She was placed in an oxygen tent for three weeks; she was given opiates, stimulants, transfusions of blood, and drugs and was fed intravenously and her stomach continuously pumped. Two consultants found the patient to be suffering from peritonitis and paralysis of the large bowel.

After five months of hospitalization, the patient was again operated upon by another surgeon, one of the consultants, who removed her ovaries, having found them cystic, enlarged, and diseased.

The first physician was charged with an unauthorized hysterectomy without an incision in the abdomen, after employment for curettage. According to the intern who assisted at the operation, curettage was attempted, but "because of difficulty encountered in trying to dilate the cervix preparatory to a curettage, for some reason the dilation and curettage was not performed and the attending physician did a vaginal hysterectomy." This testimony, stated the court, raised the inference that the hysterectomy was performed without consent; the hysterectomy was not discretionary on the part of the physician in his duty to

3. Mohr v. Williams, 95 Minn. 261, 104 N. W. 12.

4. Rolater v. Strain, 39 Okla. 572, 137 P. 96.

the patient, nor was it an emergency operation necessary for preservation of the patient's life or health, nor was it one in which it was impracticable to obtain consent of the patient or one qualified to give consent.[5]

### FORM OF CONSENT

On admission, the usual method is to have the patient sign a form giving consent for treatment or operative procedure. Unless the patient is of age, or the party signing is the one legally responsible for the patient, the signature should not be accepted. If the patient, after admission, refuses to sign a permit for operation, a release should be obtained from him; he does not have to accept the advice of the physician even though the surgery is necessary to save his life.

The consent to perform an operation is not valid if obtained by representations which are false to the knowledge of the surgeon, and the performance of such an operation constitutes an assault on the patient for which the surgeon is liable.[6]

A consent form signed in blank by a patient who does not know what he is signing is practically valueless. Consent must be "understandingly" given; a simple and sufficient explanation should be made to the patient so that he may not claim he did not know what he was doing. The nature of the operation should be described in a few simple words understandable by the average layman rather than in technical terminology such as "enucleation," "colpohysterectomy," and so forth.

The consent should be as specific, concise, and direct as possible. "Blanket" consent forms purporting to authorize any and all procedures are undesirable, unless the operation contemplated is also specifically included, to preclude the patient from proving that an operation was performed different from the one agreed to.

If surgery is likely to result in sterility, the patient should be so advised and authorization of both spouses secured, also indicating that sterilization is not guaranteed.[7]

Specific consent for every operation should be secured in writing. While verbal consent is sufficient if the patient does not deny it, a written instrument cannot easily be overcome by oral testimony.[8]

Upon examination by two physicians, a patient was found to be suffering from nausea and to have a mass in the lower right abdomen. A cystoscopic examination revealed that the bladder was occupied by a stone approximately the size of a baseball. Throughout the examination the patient was conscious and in full possession of his mental faculties. He was advised of this condition and informed that he could not survive if the stone was not immediately removed. He thereupon consented to the operation, which revealed an aggravated vesical abscess, from which the patient died shortly thereafter.

A written consent to the operation had been given by an adult sister of the patient, upon the insistence of one of the nurses at the hospital. The sister told the nurse that the consent should have been executed by the patient's mother who was not then at the hospital.

The mother contended that the operation was performed on the son without her consent; that she was

5. Beringer et al. v. Lackner, Excx., 331 Ill. App. 591, 73 N. E. 2d 620.
6. Birnbaum v. Siegler, 76 N. Y. S. 2d 173.
7. Regan, Louis J.: The right record saves money. Hospitals 18:65, Sept. 1944.
8. Barbour, H. V.: What constitutes body attack in medical practice? Am. J. M. Jurisp. Sept. 1938, p. 9.

the proper person to give such consent, and that therefore an assault was committed on her son for which she was entitled to compensation. Her claim was dismissed by the court, which found that the deceased did give his consent and was conscious and in full possession of his mental faculties at the time.[9]

### AUTHORITY IN EMERGENCIES

Surgeons are called upon daily to operate in emergency cases in order that life may be preserved. Many small children are injured upon the streets in large cities. To hold that a surgeon must wait to secure the consent of the parents before helping the injured might result in the loss of life. It is not to be presumed that competent surgeons will wantonly operate.

A case involved the amputation of the foot of a 15 year old boy who had been thrown under the wheels of a car. His left foot was mangled and crushed. Soon after his arrival at the hospital his foot was examined by four house physicians, who concluded prompt surgical treatment was necessary.

An assistant surgeon was called, and he, after consultation with the four house physicians, decided that an immediate amputation was necessary to save the patient's life. The foot was amputated; the patient recovered.

It was claimed by the patient that his foot should not have been amputated, and particularly that it should not have been amputated without first obtaining his consent or the permission of his parents, who went to the hospital as soon as possible after learning of the accident.

In dismissing the complaint, the court declared that: "In such event a surgeon may lawfully, and it is his duty to, perform such operation as good surgery demands without such consent."[10]

It is an established principle that if a surgeon is confronted with an emergency which endangers the life of the patient, he is under a duty to do that which the occasion demands within the usual and customary practice among physicians and surgeons in the same or similar localities, without the consent of the patient.

Thus, where a 7 year old boy, living with his parents, was injured by a freight train and sustained a compound, comminuted fracture of the elbow joint, the court held an amputation of the arm to be justified after a consultation and the determination that the case was one of surgical emergency. "If the surgeon is not to be permitted to honestly use his best judgment upon the necessity for an operation, without waiting to get the consent of either the patient or his parents, then is the skilled hand of the expert stayed by an unreasonable rule, often to the detriment of the patient and humanity at large."[11]

In emergency cases, a hospital does not undertake to render any service other than that which is reasonably required by the character of the injuries; there is no inference that the institution agrees to do more than what is immediately necessary.[12]

An emergency case is one "in which the condition of the person to be operated upon indicates immediate surgery and in which case the time required to make a pre-

9. Arballo v. Nielson, 166 P. 2d 621 (Calif.)

10. Luka v. Lowrie, 171 Mich. 122, 136 N. W. 1106.

11. Jackovach v. Yocom, 237 N. W. 444 (Iowa).

12. Gadsen General Hospital v. Bishop, 209 Ala. 272, 96 So. 145.

operative study and diagnosis would seriously endanger life."[13]

Emergencies have been classified according to nomenclature as follows: acute abscess; Addison's disease (in crisis); acute appendicitis; severe blood disease; acute burns; cardiac disease in collapse; acute cholecystitis; coma; acute communicable disease; craniocerebral trauma with subdural or extradural hematoma; croup; diabetes complicated by presumptive acidosis; severe diarrhea and vomiting; embolus with gangrene of arm or leg impending; empyema; and severe feeding problems.

Other diagnoses in the emergency group are: foreign bodies in bronchi, esophagus, eye, gastrointestinal tract, or trachea; fracture or dislocation of spine; intervertebral disk rupture if incapacitating; gangrene; acute glaucoma; congestive or anginal heart failure; severe hemorrhage; hypertrophic pyloric stenosis of infants; severe infections; severe injuries; mediastinitis; meningitis; severe metabolic disorders; nephritis, if acute or complicated by uremia; obstruction of genitourinary system (severe), intestine, or common duct; acute pancreatitis; peritonitis and complications; complicated or tubal pregnancy; normal delivery, premature birth; pulmonary pyocyst; detachment of retina; acute rheumatic fever; rupture of spleen; tetanus; brain tumor; severe hemorrhage; obstruction of respiration caused by thyroid; spinal cord tumor; therapeutic abortion.[14]

To constitute an emergency, it is not merely necessary that treatment be reasonably needed for the preservation of the life, limb, or health of the patient; the operation must be emergent in the sense that death would likely result upon failure to perform it.[15]

Unless an emergency exists, the patient must be the final arbiter as to whether he will take his chances with the operation or of living without it; the patient does not have to accept the advice of the hospital physicians.

### EMERGENCY DURING OPERATION

When a person has selected a surgeon to operate upon him and has appointed no other person to represent him during the period of unconsciousness, the law will by implication constitute such surgeon the representative *pro hac vice* of his patient and cast upon him the responsibility of acting in the interest of the patient.[16]

In one case the patient consented to a herniotomy on the left side, but on opening the abdomen the surgeon found a hernia on the right side which was far more serious than the left one. According to the physician's testimony, there was a condition which was dangerous both to the life and health of the patient. The court exonerated the physician on the ground that the emergency justified the operation without the patient's approval.

In another action, there was evidence on behalf of a patient that the doctors, before giving the patient an anesthetic, told him they would be able to reduce the fracture, under an anesthetic, by manipulation, without surgery. This testimony was strenuously denied by the physicians.

13. Bill would prohibit operations without preliminary study. Mod. Hosp. **65**:130. May 1945.
14. Patients' priority—an admitting plan designed to solve wartime overcrowding. Hospitals **19**:39, June 1945.
15. Rolater v. Strain, 39 Okla. 572, 137 P. 96.
16. Bennau v. Parsonnet, 83 A. 948, 83 N. J. L. 20.

The patient admitted that the surgeons were called to reduce the fracture. The court ruled that, if, during the course of the attempted reduction by manipulation, the doctors failed, they were not required to restore the patient to consciousness for the purpose of procuring consent to surgery, the only alternative. "The use of anesthesia in modern surgery has modified to some extent the ancient rule of the common law requiring consent. Of course the general rule requires consent of the patient, but consent may be implied from circumstances and an operation may be demanded by an emergency without consent."[17]

Likewise, if during the operation a condition arises which constitutes a medical emergency, the doctor has the right to extend the scope of the operation in the interests of good surgery.

A physician who had been engaged to treat a female patient during her period of pregnancy made a diagnosis of tubal pregnancy based on certain complaints. He called a surgeon into consultation, who found a mass the size of a small orange in the right ovarian region. From that and other symptoms he made a diagnosis of a tubal, or extrauterine, pregnancy and recommended an operation.

The operation was performed under anesthesia. Upon opening the abdomen, the surgeon found that his original diagnosis of tubal pregnancy was mistaken, and that a normal pregnancy was present in the uterus. He also discovered a very acute condition of the appendix, as well as a double uterus. Deciding that the acute appendicitis had caused the patient's abdominal pains, he removed the appendix.

When the surgeon sued for his fee, his claim was resisted on the ground that the appendix had been removed without the patient's consent and that the operation, having gone further than was authorized, constituted a trespass or assault.

The question for decision was whether an emergency existed requiring the removal of the appendix without the express consent of the patient. No claim was made that the physician used bad judgment, or that the operation was not dictated by sound surgical procedure, or that it was a failure, or that there was real resulting injury or damage. The patient asserted only that is was unauthorized.

To deny the surgeon his fee, under such circumstances, because he came into court unable to show express authority for the excision he made would tend to make every surgeon litigation conscious instead of duty conscious as he stands, scalpel in hand, over his unconscious patient. "We hold the law to be that in case of emergency, a surgeon may lawfully perform, and it is his duty to perform, such operation as good surgery demands even when it means extending the operation further than was originally contemplated."[18]

Moreover, it would be unreasonable to hold a properly qualified physician or surgeon responsible for an honest error of judgment, for when he is called upon to act in an emergency, he must choose between two courses of action, either one of which may involve the gravest hazard to the patient. In such cases the court and jury do not undertake to determine what is the best mode of

17. McGuire v. Rix, 118 Neb. 434, 225 N. W. 120.

18. Barnett v. Bachrach, 34 A. 2n 626 (D. C.).

treatment or to decide questions of medical science upon which surgeons may differ among themselves.[19]

It is a well recognized fact that physicians act in emergencies; if a surgeon waits too long before undertaking a necessary amputation, he must be held to have known the consequences of such delay; he may be liable for the resulting damage.[20]

"In cases of emergency celerity rather than formality of action is essential, else, while adjusting and applying the ordinary red tape, the death of the patient may end the need for human succor."[21]

### RESTRICTIONS ON OPERATIONS

Suit was brought for malpractice, the claim being that during the course of a minor operation under local anesthesia the surgeon discovered a more serious condition and thereupon operated without disclosing the facts to the patient or getting her consent for the more extensive surgery.

The physician had felt a cyst on the neck of the patient, which he thought was small and could be taken out in ten minutes. On operating he found that this cyst had actually extended down between some muscles. Before he commenced to operate, he discovered how deeply embedded it was. Instead of advising the patient of the possible danger of the operation and securing her consent to perform it under the new and correct diagnosis, he went ahead with the new found conditions. All during the operation the patient was fully conscious.

In performing the operation the surgeon injured a facial nerve which caused certain facial deformity and paralysis of the tongue. Under such conditions, commented the court, when a consent is obtained under a mistaken diagnosis that the operation is simple and without danger, and a later diagnosis, made while the patient is still conscious and no emergency exists, discloses that the operation is both difficult and dangerous, the surgeon must make full disclosure and secure consent to proceed under the newly discovered conditions.

"If a physician advises his patient to submit to a particular operation and the patient consents, he thereby in effect enters into a contract authorizing his physician to operate to the extent of the consent given, but no further. Similarly, a surgeon may not perform an operation different in kind from that consented to or one involving risks and results not contemplated."[22]

When the patient engages the services of a surgeon without any agreement as to what he is to do, the law authorizes the doctor to do what he considers necessary. He may, under such circumstances, go beyond what either he or the patient originally contemplated.

A woman came to a surgeon and stated she had suffered from miscarriages and desired to bear children; for that purpose she asked to be "fixed." In the course of the ensuing operation the doctor found both ovaries sealed and adhesions about the uterus and intestines, whereupon he removed the diseased organs and contiguous infected tissues.

An action was brought against him by the patient for an assault. He was discharged of liability by the court, which declared that the

19. Williams v. Poppleton, 3 Ore. 139.
20. Staloch v. Holm, 100 Minn. 276, 111 N. W. 264.
21. Dykes v. Board of Com'rs of Stafford County, 86 Kan. 697, 121 P. 1112.
22. Wall v. Brinn, 138 F. 2d 478.

woman's request to be "fixed so as to have children" authorized the doctor to diagnose her condition to discover the exact cause of her sterility and to make the necessary exploratory incisions. That the patient believed her condition was caused by a laceration of the uterus did not relieve the surgeon of the duty of discovering for himself the cause of her sterility.[23]

A suit was instituted against a surgeon who owned and operated a hospital. He operated upon a pregnant patient for appendicitis and then instructed her to use certain medicines by means of hypodermic injections to be administered by another physician.

When she complained that the medicines made her ill, the surgeon directed her into his operating room and strapped her down on the table, under the pretext that he wished to examine and treat the incision through her vagina and uterus. When the woman realized he was about to perform an operation, she protested vehemently; nevertheless, he inserted an instrument into her vagina and womb and dismembered her unborn child. Another physician soon afterward removed the remainder of the body.

He was sued by the patient for an unauthorized operation. Her petition, the court stated, clearly set forth a cause of action for an assault. "Where a surgeon enters into an agreement with a person merely to perform a certain operation, and the surgeon, in violation of the contract, goes further, without an emergency, and performs another operation which is unauthorized by the agreement, or by an emergency necessitating the additional operation, and injury results to the patient, the surgeon cannot relieve himself from liability by showing skill and care in the other operation."[24]

Two physicians were sued by a patient who alleged that he had engaged one to treat him for an illness involving the groin, the appendix, and the rectum; that this physician sent him to another doctor, at whose office both physicians told the patient it was necessary to inject a needle in a cyst in his scrotum to withdraw fluid. The cyst was punctured, causing the patient to lose much blood and to suffer severely. An operation was then performed and the scrotum opened in order to tie a vein which had been torn when the cyst was punctured.

Damages were claimed by the patient for his suffering by reason of their alleged malpractice in the unnecessary and negligent operation. Although the doctors were absolved of negligence, the court stated the jury could have found, if it believed the patient, that the needle was to be used for diagnostic purposes only; that when the doctors proceeded to perform the surgical operation, it was not only without the consent of the patient but in direct contradiction of the first physician's statement of what was to be done. "The plaintiff had the right to decide whether or not he should be operated, which right would attend no matter how necessary the operation, nor how imminent the danger if it not be performed."[25]

At the Ohio Valley Hospital, x-rays were taken of the cervical region of a patient's spinal column. Various interpretations were made

23. King v. Carney, 85 Okla. 62.

24. Keen v. Coleman, 20 S. E. 2d 175, 67 Ga. App. 331, followed in 20 S. E. 2d 179, 67 Ga. App. 337.

25. Gregorias v. Manos, 40 N. E. 2d 466 (Ohio).

of this film, from a fracture of the cervical vertebra to subluxation and "out of alignment." The attending physician then referred him to a consultant, who ordered x-rays taken at the St. John's Hospital. The films clearly showed a fracture of the transverse process of the sixth cervical vertebra right.

Two charges were made by the patient against the operating surgeon: negligence in operating and want of authority. The patient testified that the doctor had told him an operation must be had on the shoulder to remove a "chip of bone"; the patient also knew that the neck was to be involved in the operation. The patient said "O.K., doctor; don't go too much up in the neck." On the following day he was operated upon.

The court instructed the jury that there was no evidence tending to show the operation was negligently performed; that the only subject for consideration was the lack of authority to operate. These undisputed circumstances, the court held, permitted the surgeon to believe that the patient had assented to such operation as approved surgery considered necessary. Consent could be inferred from all the circumstances. Dismissal of the complaint followed.[26]

### CONSENTS FOR MINORS

The general rule is that the consent of the parent is necessary for an operation on a child. To that rule there are certain exceptions: One is in cases of emergency; another where the child has been emancipated from the control of his parents; another where the parents are so remote as to make impracticable the obtaining of their authorization in time. Where the child is close to maturity, the surgeon may be justified in accepting the minor's consent.

In all such cases, the basic consideration is whether the proposed operation is for the benefit of the child and is done with the purpose of saving his life or limb.

An illustration of an operation not for the child's benefit is the case of a 15 year old boy. This boy's female cousin had been admitted to a voluntary hospital, where a physician advised a skin graft for the girl who had been burned severely.

After unsuccessful efforts to get suitable blood donors, the mother of the girl persuaded the boy to go with her to the hospital to have a blood test made. He provided the transfusion. After the operation the boy advised his mother, who had not known about the operation, that he was going back to the hospital to have his side "fixed up."

In the subsequent operations, a tube of flesh was cut and formed from his armpit to his waistline; one end of the tube was attached to his cousin. The result was unsatisfactory. The tube was severed, but not until the boy had lost a considerable amount of blood and himself required transfusions.

The operation was not for the benefit of the boy; the procedure was so involved as to require a mature mind to understand it. Moreover, the doctor had failed to explain the nature of the proposed first operation.

Although the operations had been unauthorized by the mother, the court said that the physician would be permitted to prove that the mother's attitude was such in allowing the boy to return for the completion of the experiment as to be tantamount to ratification of the un-

26. Dicenzo v. Berg, 17 A. 2d 15 (Pa.)

authorized operations. She had boasted of the boy's courage in submitting to the operations and basked in the publicity given to him.[27]

A 9½ year old boy, in the fourth grade, was taken by a visiting nurse to the city physician for examination. There being some suspicion of infected tonsils, the city physician sent him to a hospital with a written memorandum requesting removal of the boy's tonsils and adenoids.

The boy, accompanied by his 15 year old brother, went to the hospital where his tonsils were removed. Neither the city physician, nor anyone acting for the operating surgeon, obtained the permission of either parent to operate. Not until the older boy reported the facts to the parents did they know that their son was in the hospital.

Here no emergency existed, nor was the operation justified by the age of the child or the presence of adult relatives, nor was there any indication that the parents would have approved had they known of the proposed operation. Nominal damages were awarded to the child.[28]

### Consent of Mature Minors

The fact that the patient is a minor does not necessarily mean that the parent alone must be the one to authorize the operation. If the minor is of sufficient maturity and understanding, the circumstances may be such as to make the minor's consent adequate.

A 17 year old patient died upon the operating table at a hospital while chloroform was being administered preparatory to the removal of a tumor.

The boy lived with his father on a farm. He had a tumor upon his left ear about the size of a dove's egg. Some time before he had received treatment, and the tumor disappeared; later it reappeared. With an elderly aunt and two adult sisters he went to the office of a surgeon who referred him to a specialist. It was decided to remove the tumor by surgical operation at the hospital.

The patient, his aunt, and at least one sister understood an operation was to be performed. An examination of the heart and lungs of the young man indicated they appeared normal. While chloroform was being administered, the heart of the patient stopped beating.

The father, in his action for damages, alleged the patient was a minor and so known to the two doctors (the anesthetist and surgeon) who were defendants; that it was the duty of the surgeon to inform the father and get his consent before entering upon this operation.

Dismissal of the complaint against the doctors was upheld on appeal. The court emphasized that the patient was almost grown to manhood. He had been, for a considerable time, while living with his father, afflicted with a tumor which he attempted to have cured with his father's knowledge. He submitted, after certain examinations, with the knowledge of his adult relatives to a surgical operation of a simple character. There was nothing to indicate that, if the consent of the father had been asked, it would not have been freely given, nor was there anything to show to the doctors that the father did not approve of his son's consulting a physician as to his ailment and following his advice.[29]

27. Bonner v. Moran, 126 F. 2d 121 (App. D. C.)

28. Zoski v. Gaines, 271 Mich. 1, 260 N. W. 99.

29. Bakker v. Walsh, 144 Mich. 632, 108 N. W. 94.

### AUTHORITY OF SIBLINGS

If a minor is involved, the parents should be consulted for authorization. Sisters of the patient, where parents are available, have no authority to give consent.

A surgeon was alleged to have caused the death of an 11 year old girl by an operation without the consent of the child's father.

The child was placed by her father in the immediate care and custody of her adult sister. She took the child to San Antonio, 60 miles away, to a surgeon, the defendant, to ascertain whether an operation was needed for the removal of adenoids, since the child had difficulty in breathing and was subject to attacks of rheumatism.

An examination disclosed badly diseased tonsils and the appearance of adenoids; that a necessity existed for an operation to remove them. A date was then agreed upon for the operation with the sister and another sister, who had had two years' training as a nurse. The tonsils and adenoids were removed, but before coming from under the influence of the anesthetic, the child died.

At the trial the evidence showed that there was an absolute necessity for a prompt operation, but not emergent in the sense that death would likely result immediately upon failure to perform it. In fact, it was conceded that no real danger would have resulted had time been taken to consult the parents.

The physician undoubtedly acted in good faith in assuming the sisters had authority to give consent for the operation.

Although the adult sisters had temporary custody of the child, such custody was held to be insufficient. The parent was the only one who could legally give consent to perform the operation, and, if not given, the physician's act in performing it was a legal wrong for which he was liable.[30]

### SUMMARY

Authorizations should be in writing. To avoid misunderstanding as to the nature and extent of the operation to be performed, the permit should provide for "the administration of any anesthetics and the performance of any operations which the surgeons in attendance deem advisable. If it is necessary to amputate or remove any material, the hospital or its agents are authorized to make proper disposition thereof. It is further understood (amputations, eye-enucleations and similar operations should be specifically named) are specifically included in this authorization."[31]

30. Rishworth v. Moss, 191 S. W. 843 (Texas).

31. Hayt, Emanuel: The courts value consent for surgery on minors. Hospitals **19**:58, Sept. 1945.

## PNEUMOTACHOGRAPH

(*Continued from page* 42)

condition duplicate those of the above patients.

It is evident from these records and several others which have been made on other children and laboratory animals that anesthesia or medication results in uniform damped respiratory records of decreased amplitude. Further studies on pneumotachographs taken on patients are now under investigation.

# NOTES

*When anesthetists get together, they talk about anesthesia. They talk about gadgets, special technics, and interesting cases. This section of NOTES was originated so that anesthetists could exchange ideas in writing as they do in conversation. Send in your contribution now. Other anesthetists will be helped by it.*

Pentothal Tray.—Early in 1940 when I first began to use pentothal sodium, we had no special equipment available for its administration. In order for the anesthetist to observe the patient properly and carefully, it was necessary to have someone hold the syringe constantly and give the pentothal sodium as directed.

The Gilson one way valve, manufactured by Becton, Dickinson & Co., came to my attention in 1941, and it has since proved a most satisfactory answer to my problem. It is a simple, compact, efficient, and inexpensive piece of equipment.

Our sets for administration of pentothal sodium are kept in 6 by 10 inch trays with covers, sterilized and ready for use. A tray contains the following equipment:

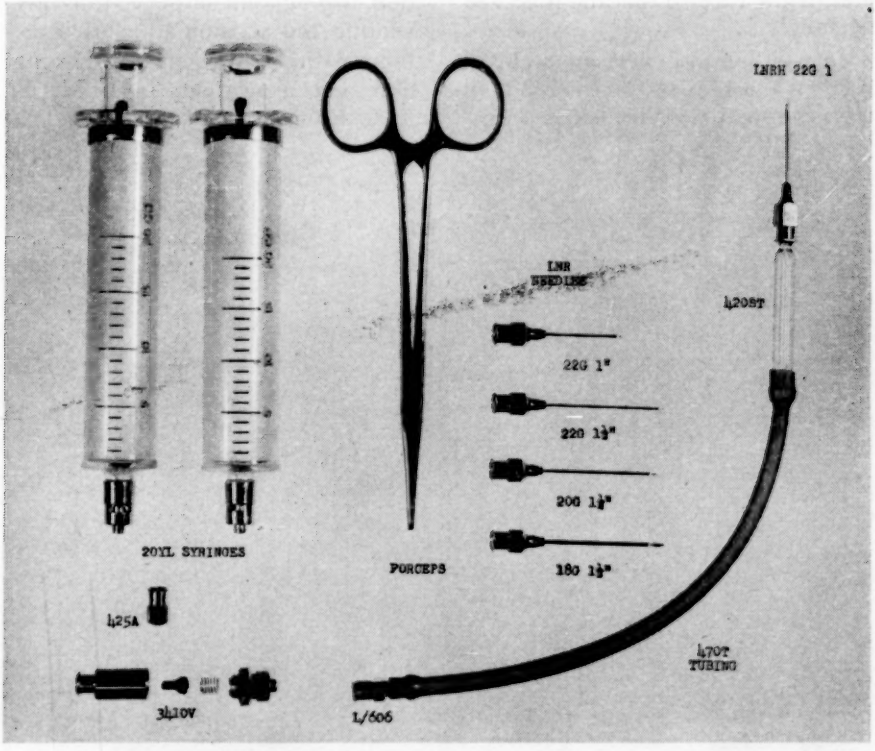
2 20 cc. Luer-Lok syringes
1 Gilson valve set-up, with rubber tubing and observation glass and needle attached
2 Needle caps
1 18 mixing needle
1 20 1½ in. needle
1 22 1½ in. needle
1 22 1 in. needle
Preparation sponges and a forceps

The anesthetists clean and put up the sets for administration of pentothal sodium and therefore always know the needles are sharp and that everything is in good working order. Several sizes of needles are included in each set to give the individual anesthetist her preference. Personally, I prefer a 1¼ inch 22 Huber point needle.

We use a 2½ per cent solution of pentothal sodium and keep several 20 cc. syringes of this solution available at all times. The tips of the syringes are capped and may be kept for forty-eight hours or longer. Any pentothal sodium left over from a case is always saved, since the one way valve prevents any contamination. This means considerable saving of solution.

The anesthetist who uses the one way valve inserts the needle in a vein and fastens it in place with adhesive. She is then free to give full attention to taking blood pressure, supplementing the anesthetic with oxygen or gas, and keeping the records. The Gilson one way valve permits no back flow of blood, and the needle may be kept open for several hours by frequent small additions of pentothal sodium. If the patient is getting fluids, the needle for giving pentothal sodium may be inserted into the intravenous tubing.

Our pentothal sodium equipment is inexpensive and easy to use. The rubber tubing or parts, such as the




rubber valve, spring, or washers, may be replaced at a small cost. —HAZEL J. PETERSON, R.N., Minneapolis.

REVITALIZED EQUIPMENT.—When the inside of the mask attachment begins to resemble the inside of a scaly teakettle, soaking it in vinegar will help to remove those scales. This is particularly effective if it is done before the scales get too thick.

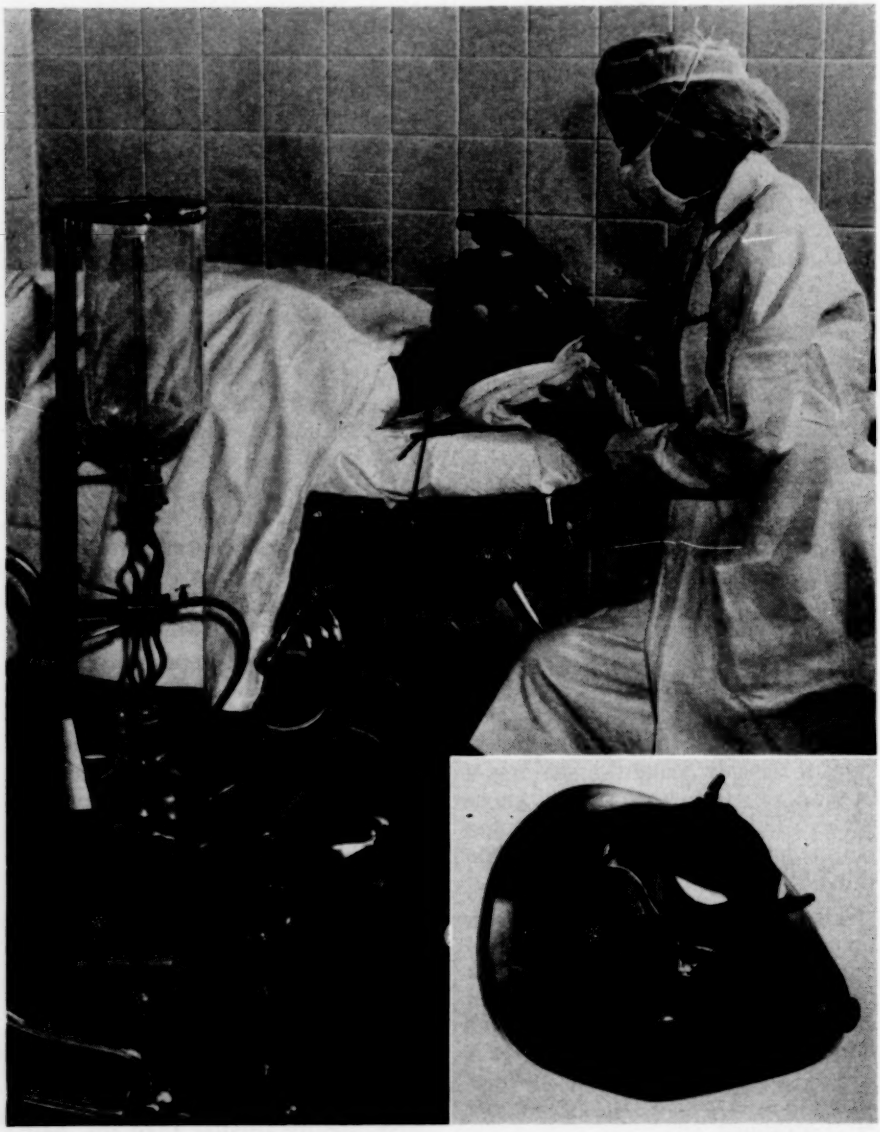
The life of the rubber parts on the gas machine can be lengthened by soaking them about once a week for several hours or overnight in ammonia solution. Three or four ounces of household ammonia to a gallon of water is the proper strength.—HARRIET L. ABERG, R. N., Galesburg, Ill.

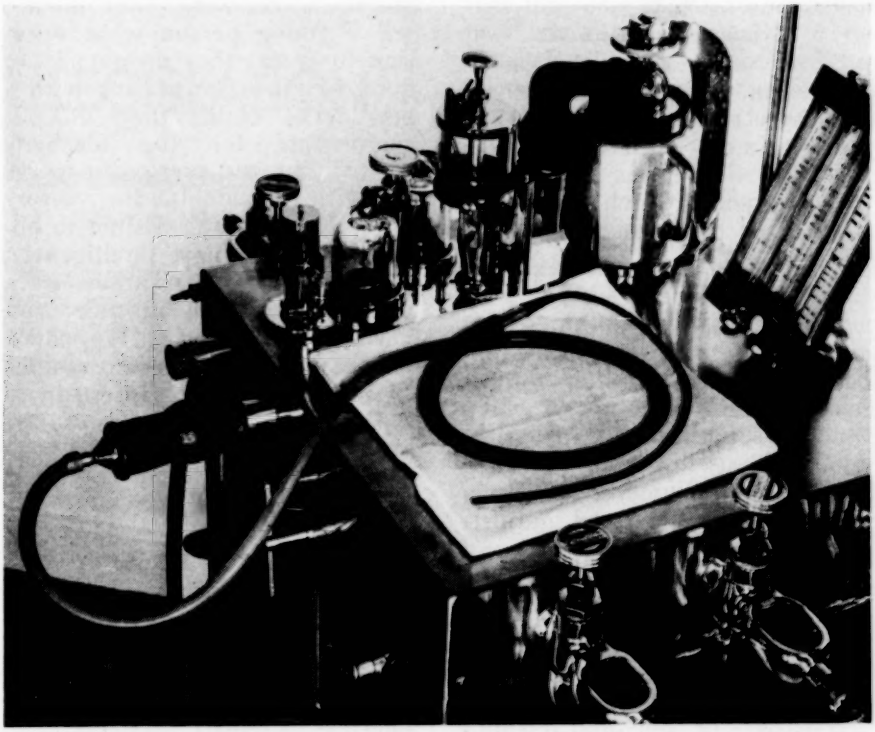
FACE MASK MODIFIED TO ACCOMMODATE GASTROINTESTINAL SUCTION TUBE.—Many anesthetists have had difficulty in securing a closed system on patients who must have inhalation anesthesia with a Levine or similar suction tube in place. This problem has been solved at the Wesley Memorial Hospital by the simple expedient of making a hole in the mask, through which the tube can be drawn, as illustrated, and attached to the suction apparatus.

The hole is made with an electric drill in the solid part of the mask, the air cushion being avoided. The left side, close to the nose, is chosen because of the convenience of having the suction appartus on the left. The aperture should be symmetrical and slightly smaller than the diam-

eter of the tube so that the tube will fit snugly.

In addition to permitting a closed system anesthesia, this method allows the suction to be kept in operation throughout surgery, thus preventing the accumulation of secretions with the danger of regurgitation and aspiration. — O. M. S., R.N., Chicago.





A SIMPLE AND USEFUL ATTACHMENT FOR THE GAS MACHINE.—The illustrated device has been found effective for the administration of oxygen by nasal catheter during regional anesthesia. It consists of a rubber connector with metal adaptor for rubber tubing to which the nasal catheter is attached. The rubber connector fits over the inspiratory opening of the gas machine. The openings for the breathing bag and expiratory tube should be blocked off to prevent back flow of oxygen and consequent waste. The tubing is of sufficient length to permit convenient handling of the nasal catheter. This method of giving oxygen can be used continuously while permitting the anesthetist to have both hands free, and it is usually more comfortable for the conscious patient than is the face mask.

An increased oxygen concentration is frequently very beneficial during drop ether or Vinethene anesthesia. This attachment can be used very conveniently to flow any desired amount of oxygen under the mask. It can also be used during the occasional pentothal sodium anesthesia when it is impossible to use a face mask without interfering with the surgeon. In such a situation nitrous oxide and oxygen have been administered by nasal catheter. While this is less efficient than closed system nitrous oxide and oxygen supplement, it is effective in reducing the pentothal sodium requirement. — O. M. S., R.N., Chicago.

## TESTS

(*Continued from page 12*)

There are tests of emotional and social maturity, and there are tests of personality. They must be used with due respect for their limitations as well as for the values which they have when used cautiously.

### Summary

Two important periods for evaluation have been stressed: First, before admission to the school of anesthesiology, at which time it is important to learn as much as possible about the applicant's intelligence, achievement, personality and adjustment, environmental history, and health; second, the period of time spent in the school of anesthesiology. During this period major consideration is given to achievement and adjustment.

A variety of tools and technics can be used: tests—written, oral, and performance; rating devices and anecdotal records; interviews, individual and group conferences. All our efforts, however, are directed toward selecting persons who seem to have the potentialities for becoming "fine anesthetists." A fine anesthetist is competent in her field, a mature person with interests and goals above and beyond self interests, with the ability of objectivity and with a unifying philosophy of life.

Technics described here and many others not mentioned can be used in evaluation of students who practice anesthesia. But, to quote Ruth Strang,[4] "There is no magic in technics. They do not tell a young person what vocation to enter; they do not insure good judgment in dealing with a bewildered child; they do not compensate for the teacher's lack of time and energy for working with individuals. But, wisely used, they help the teacher to observe students more intelligently, to record his observations in a more permanent, useful, and meaningful form, and to check and supplement his impressions of the abilities and interests of individual students and of the group as a whole."

4. Strang, Ruth: *Personnel Work* (New York: Bureau of Publications, Teachers College, Columbia University, 1948).

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## HEART DISEASE

(*Continued from page 24*)

been rare, but some degree of hemothorax is seen in perhaps half of the patients. This may be insufficient to require aspiration.

Posture paralysis of the arm on the operative side has been anticipated, so considerable care is taken to pad this arm well. Thus far we have had no nerve palsies and no permanent incapacity due to circulatory impairment.

### Summary

Various aspects of management in anesthesia for congenital heart disease, based on a total of 700 cases, have been presented.

Some modifications in technic have been adopted since our initial report in the *JOURNAL*.

For best results it is essential that the anesthetist understand both the anatomic and the physiologic derangement in these patients, before and after surgery.

# LEGISLATION

**Emanuel Hayt, LL.B.***

THE FREE-LANCE ANESTHETIST.—A free-lance anesthetist is legally responsible, just as is any other anesthetist, in case of an anesthesia accident or death to the patient, even though she is not employed by the hospital but administers the anesthetic at the request of the surgeon, provided that she has been personally negligent in some manner.

The hospital determines whether or not a free-lance anesthetist may administer anesthesia in the institution. If the rules of the hospital permit nurse anesthesia, the doctor must abide by such ruling if he chooses to remain on the staff. The matter is one of hospital policy rather than of law. A surgeon can be required to accept the anesthesia service of a nurse anesthetist if she is competent, if the rule of the hospital so specifies.

The employment of a free-lance anesthetist by a surgeon cannot be regarded as fee-splitting, because he is not paying her a commission, but is compensating her for her services. However, the compensation must be reasonable and what is customary, and not be used as a guise for fee-splitting.

WHO MAY ADMINISTER ANESTHESIA IN A HOSPITAL.—If the medical board adopts a resolution, which is approved by the Board of Trustees of the hospital, to the effect that only medical anesthetists may administer anesthesia in the hospital, all those on the staff are bound by the rule. The hospital has the right to determine who may use its facilities and under what conditions.

The nurse anesthetist may administer anesthesia in the hospital under the supervision of a member of the medical staff provided that the rules of the hospital permit her services. She is not practicing medicine when she performs such work under the direction and supervision of licensed physicians.

The physician may add the cost of her services to his bill and pay her in that way, or she may bill the patient directly, provided her services have been performed under the physician's direction and supervision. The physician has implied authority to employ an anesthetist if necessary.

The matter of who should administer anesthesia in the hospital is primarily one for the medical board and the Board of Trustees, and any relief should be sought from them. The courts have no jurisdiction, nor does any other body, such as the American College of Surgeons, to require the employment of nurse anesthetists if the hospital decides otherwise.

*Counsel for A.A.N.A.

## MALPRACTICE INSURANCE

With the co-operation of Mr. Emanuel Hayt, the Association's efforts to secure a malpractice liability policy for its members in good standing have been brought to completion.

A letter explaining the highlights of this program and an application form are being mailed to each member.

## TEACHING

(*Continued from page* 18)

presentation and assimilation of educational material recognizes this principle.

4. *Socialize stimuli and responses wherever possible.* Shared experiences are enriched experiences; therefore, provide for as much cooperative group participation as the worth of that which is communicated justifies.

5. *Evaluate what is done every stage of the way.* This is the royal road (if any) for rising above the humdrum routine of repetitive exercises. Ask critically: What is the true worth of all items included as compared with those excluded? Measure and appraise in terms of Ultimates (e.g., the preservation of life) wherever possible.

6. *Experiment with variable sequences.* This means that no One Best Order of presentation is known with certainty, but that the search for such may always profitably go on.

7. *Teach "Much" in preference to "Many,"* or, in different terms, convey Intensity as well as Extensity. A relational system should appear in what is offered if it is to be reconstructed most effectively in the learner's mind. Never forget that the human brain is essentially an associative mechanism, and that it illustrates the general laws of interdependence and correlation found throughout all nature.

8. *No Impression is complete without some corresponding Expression.* That is good Jamesian doctrine which Dewey has popularized in his famous stress on the need to Do. Most of our body weight is muscle; all knowledge and feeling reach their climax in action; and the best teacher action is that which evokes Pupil Reaction.

Summary

All that has been offered here is much too skeletonized and formalized to do more than provide a rough outline of those features of General Method which currently belong within a systematic psychology of the teaching process. But with this as a clue, I am sure that every individual or group headed upward and onward will be able to turn these suggestions to good professional use.

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## PENICILLIN

(*Continued from page* 34)

The possibility of a severe reaction cannot be disregarded, and some clinicians believe that with low dosage and resultant low blood levels the possibility of the development of a penicillin-resistant strain of bacteria should not be overlooked. Most workers agree that, in serious infections, aerosol therapy should supplement rather than replace other methods of administration and other kinds of treatment.

Summary

The introduction of the inhalation method of penicillin administration has opened a new field of therapy that offers many interesting and perhaps valuable possibilities. Aerosols of many different drugs are being considered and investigated. Because of the nature of aerosol therapy, it approaches closely the interests and responsibilities of the anesthetist. The developments in the field have been rapid and almost spectacular. The test of time has yet to be applied.

# THE NEWS

## DONATIONS TO EDUCATIONAL FUND

The Agatha Hodgins Educational Fund, provided for by a vote of the members at the fifteenth annual meeting, has received two donations in addition to the states' share of the accumulated Trust Fund converted to it by the state associations. The Florida Association of Nurse Anesthetists gave $50.00 in memory of Mary C. Brown. A contribution was also received from Alpha S. Little, a Florida member. State associations that to date have voted their share of the Trust Fund to the Educational Fund include: Arkansas, California, Florida, Kansas, Massachusetts, Michigan, Minnesota, New Jersey, North Carolina, Oregon, Oklahoma, and Utah.

The Educational Fund is to aid graduate nurse anesthetists who wish to take further training to prepare themselves to teach in a school of anesthesia. Applications for loans from the fund may be directed to Mrs. Gertrude A. Troster, chairman, 654 Stonewall Place, Memphis 7, Tenn.

### HOSPITAL OPERATING ROOM COMMITTEE

The American Association of Nurse Anesthetists has appointed Mrs. Opal Schram, R.N., Wesley Memorial Hospital, Chicago, as its representative to the newly formed Hospital Operating Room Committee of the National Fire Protection Association.

Chairman of this committee is George Buck, Mercer Hospital, Trenton, New Jersey, who is also chairman of the American Hospital Association Safety Committee.

The Committee has as its function the restudy of regulations for operating rooms to minimize anesthetic explosion hazards. Recommendations of the National Fire Protection Association

Janet D. Cabedo, president New York Association of Nurse Anesthetists

## CALENDAR OF COMING EVENTS

| | |
|---|---|
| February 7-11 | Institute for Nurse Anesthetists, Hotel Commodore, New York City |
| February 9-10 | Mid-South Assembly of Nurse Anesthetists, Hotel Peabody, Memphis |
| March 23-24 | Annual Meeting, Ohio State Association of Nurse Anesthetists, Columbus |
| April 19 | Annual Meeting, Texas Association of Nurse Anesthetists, Galveston |
| April 27-29 | Southeastern Assembly of Nurse Anesthetists, Biloxi, Mississippi |
| May 2-4 | Tri-State Assembly of Nurse Anesthetists, Palmer House, Chicago |
| May 9-12 | Western States Assembly of Nurse Anesthetists, San Francisco |
| May 18-20 | Mid-Atlantic Assembly of Nurse Anesthetists, Atlantic City |
| May 19 | Annual Meeting, Pennsylvania State Association of Nurse Anesthetists, Atlantic City |
| May 19 | Annual Meeting, New Jersey State Association of Nurse Anesthetists, Atlantic City |
| May 19 | Annual Meeting, New York Association of Nurse Anesthetists, Atlantic City |
| September 26-29 | SIXTEENTH ANNUAL MEETING, AMERICAN ASSOCIATION OF NURSE ANESTHETISTS, Cleveland |

adopted in 1944 have for several years been the subject of controversy. The purpose of the new committee will be to review these recommendations, giving particular study to the actual zone of explosive hazard in the operating room and administrative regulations calculated to minimize the hazards.

### INVENTORY OF NURSES

At the request of the National Security Resources Board, charged with advising the President concerning the co-ordination of military, industrial, and civilian mobilization in the event of a national emergency, the American Nurses' Association will direct a complete inventory of all professional registered nurses in the United States and its territories, according to Pearl McIver, president of the ANA.

In outlining the purpose of the inventory, Miss McIver said: "Actual information showing existing and potential resources of the country in regard to nursing personnel, and estimates of the military and civilian demand which would be made upon these resources, are necessary in order that the Board may carry out its functions. In peacetime, the inventory would offer invaluable data in over-all planning for the nursing profession, for nursing education, and for recruitment.

"Maintaining the census of nurses on a current basis will become a permanent, routine procedure. It is hoped that in future years state nurse-licensing boards will adopt a uniform application form for renewal of registration which will provide for information essential to maintaining an up-to-date inventory. The most important inventory, however, is

the one we are starting now. In connection with it, we must make every nurse in the country realize how vital it is for the military and civilian needs of America for her to fill out as soon as possible the census questionnaire sent her by the nurse-licensing board in her state."

The ANA questionnaire will ask all nurses for their names and addresses; their marital status and dependents; whether they are actively engaged in nursing; their field of employment and type of position; in what aspects of nursing they have had special graduate preparation or experience; whether they are at present employed by the Army, Navy, or other government agency; in what state they are now employed; and in what states they are currently registered.

Thelma A. Wilson, president Kansas Association of Nurse Anesthetists

Lucille M. Lovett, president Mississippi Association of Nurse Anesthetists

## SAN FRANCISCO CIVIL SERVICE COMMISSION EXAMINATION FOR ANESTHETISTS

Residents and non-residents may make application before March 1, 1949, for a Civil Service Commission examination for anesthetists for the City and County of San Francisco. The salary is $324.00 per month. The applicant must be a registered nurse and possess a certificate of completion of a course in anesthesia. The Commission will endeavor to make arrangements to hold this examination at convenient places throughout the United States. Interested anesthetists may apply to City and County of San Francisco, Civil Service Commission, 151 City Hall, San Francisco, Calif.

## INSTITUTE FACULTY

The pharmacologic effects of drugs on the respiratory and circulatory mechanism with emphasis on their use and abuse will be discussed at the Wednesday, February 9, Luncheon Round Table Discussion of the forthcoming Institute for Nurse Anesthetists in New York City. The specific drugs to be discussed and the moderator for each include:

*Curare*
R. W. Robertazzi, M.D.

*Pentothal Sodium*
Billie Caraway, R.N.
Vincent J. Collins M.D.

*Cyclopropane*
Sidney S. Lyons, M.D.

*Nitrous Oxide-Ether*
Charlotte McCoy, R.N.

*Spinal Anesthetic Drugs*
Margaret Sullivan, R.N.

*Analeptics*
Olga Schweizer, M.D.

*Parasympathetic Drugs*
J. Edgar Burford, M.D.

*Sympathomimetic Drugs*
Virginia Apgar, M.D.

The faculty will be composed of Karl Klicka, M.D., John Adriani, M.D., Mary deGarmo Bryan, M.D., Florence McQuillen, R.N., Charles L. Burstein, M.D., Joseph F. Artusio, M.D., William Parke, Jr., M.D., Paluel Flagg, M.D., Betty Lank, R.N., Frances Hess, R.N., Alvan Barach, M.D., Paul Dumke, M.D., and Esther Myers Stephenson, R.N. Panel discussions will be led by Harriet Aberg, R.N., Evelyn Roach, R.N., and Sister Seraphia, R.N.

## DEATHS

**J. Marie Gronvold** of St. Paul, a member of the Minnesota Association of Nurse Anesthetists, died of injuries sustained in an automobile accident on December 16, 1949. She studied anesthesia under Dr. Arnold Schweitzer of St. Paul. Twenty-five years ago she became staff anesthetist at St. Joseph's Hospital in St. Paul.

**Mrs. Martha W. Hessler,** for fifteen years a nurse anesthetist at Mt. Sinai Hospital, Cleveland, died on December 18, 1948. She received her training as a nurse at the Robinson School of Nursing, Toledo. During World War I she served as an army nurse and subsequently took postgraduate training in anesthesia at Cornell Hospital.

**Mrs. Gertrude N. Pringle,** a charter member of the California Association of Nurse Anesthetists, died on December 17, 1948.

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## HOOPER HONORED

George J. Hooper, vice president of Puritan Compressed Gas Corporation, was honored at a dinner held at the Kansas City Club, Kansas City, Missouri, in celebration of his completion of twenty-five years of service with Puritan.

Crowned "King George XXV" in an informal presentation of crown, scepter, and robe, Mr. Hooper received congratulatory tributes from the company staff members present and from Puritan offices in many other cities.

With headquarters in Chicago, Mr. Hooper is well known in the hospital field as secretary and treasurer of the Hospital Industries Association.

## QUALIFYING EXAMINATION

The next qualifying examination for membership in the American Association of Nurse Anesthetists will be held on May 16, 1949.

No applications received after April 15 will be considered.

The 263 successful candidates who took the November 15, 1948, examination have been notified.

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## "HAVE YOU SEEN THIS ANESTHETIST?"

Here is a list of members from whom first class mail has been returned without a forwarding address. Evidently, they are not receiving the JOURNAL, the *A.A.N.A. News Bulletin*, and other communications from the Executive Office. Will any member who knows of their whereabouts, please notify the Executive Office or ask them to do so.

Lois Dorothy Alcorn
Alma Edith Arney
Mrs. Mary L. Bauer
Mrs. Evelyn A. Beeler
Miss Mildred J. Camin
Miss Ruth B. Chapman
Janet K. Clark
Blanche Clause
Allie M. Crawford
Mrs. Helen P. Crossley
Mrs. Mary Butler Daniel
Rosabel DeBerry
Miss Ruth S. Elliott
Mrs. Mary Rider Erdle
Mary Helen Gaetz
Miss Mary Graham
Mrs. Margaret Green
Mamie Baker Hamilton
Mrs. Ethel C. Hanson
Janice H. Hill
Miss Bette W. Jones
Miss Onie J. Lamb
Martha Leader
Mrs. Wanda C. Lemons
Mrs. Catherine M. Meecham
Margaret A. Moore
Miss Eddie Muse
Miss Leona K. Nelson
Thelma Nelson
Reita Nolan
Louise E. Onstrand
Mrs. Rosamonde T. Pinnell
Miss Margaret R. Rahn
Frances Shelton Robertson
Frances Shuff
Esther M. Sprecher
Mrs. Vesta J. Stidston
Mrs. Cora L. Strem
Lt. Jessie M. Thomson
Mrs. Doris St. John Thrash
Florence E. Van Cleve
Addie Frances Vivrett
Erma F. Wagner
Mrs. Vivian Wiece
Estelle Whitford

Second class mail has been returned from the following members:

Mrs. Alice Lorraine Adams
Mrs. Inez S. Belch
Lillie Mae Blair
Mrs. Estelle W. Burns
Mrs. Mary Lou Dailydas
Mary Estelle Enloe
Gertrude Erickson
Mrs Marie C. Fife
Mrs. Rosemary Louise Foerst
Laverne K. Fuller
Miss Helen R. Garvey
Mrs. Ruth A. J. Grant
Mrs. Thelma P. Greenlund
Alice E. Harrison
Mrs. Catherine M. Hurn
Mrs. Gene Hynson
Mrs. Helen O. Lehr
Amelia J. Loehrke
Linda Marie Marchioni
Mrs. Dorothy W. Martin
Angeline Metzke
Miss Helen D. Nelson
Julia Norwich
Miss Fannie M. Ogelsby
Lillian T. Peake
Aldo Pearson
Mrs. Ellenor M. Penrose
Carolyn W. Polleyette
Catherine W. Raney
Mrs. Janie S. Reid
Mrs. Inez M. Roberts
Miss Margaret Rode
Mrs. Virginia W. Schaeffer
Mrs. Winifred M. Sherlock
Mrs. Marcella C. Showalter
Sister Gerharda Kettner
Mrs. Beth Smith
Miss Martha S. Solberg
Mrs. Laura Sullivan
Miss Kathryn Watkins

# A.A.N.A. COMMITTEE APPOINTMENTS FOR 1948-49

*Advisory to Approval*
Helen Lamb, chairman
Mabel Courtney
Miriam Shupp
Marion Wark Thomas

*Approval*
Gertrude Fife, chairman
Verna Bean
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## PHYSICS

(*Continued from page* 49)

rier between the liquid and the gas. As you no doubt know, most of the gases used in anesthesia are highly soluble in fats and are not so soluble in water or blood. This fact was used by Meyer and Overton in the Meyer-Overton theory to explain why anesthetic gases are effective in suspending the activity of nerve cells. Nerve cells are of all the tissues of the body next to fat cells the richest in fat and would naturally be expected to imbibe the greatest amounts of these anesthetic gases. The amounts dissolved will, by Henry's law, be proportional to the partial pressures of the gases present.

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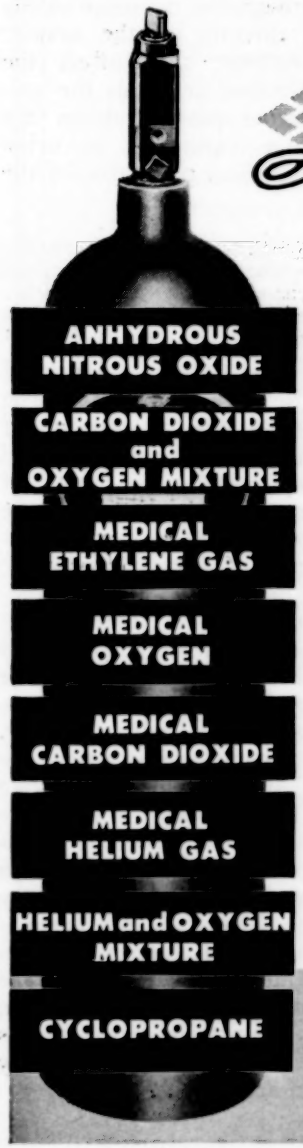


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# ABSTRACTS

SCHERF, DAVID: Effect of fagarine on auricular fibrillation. Proc. Soc. Exper. Biol. & Med. **67**:59-60, Jan. 1948.

"In 1932 it was demonstrated that an alkaloid from an Argentinian plant, *Farga coco,* exerts a depressant action on the heart. Subsequent investigations showed that the purified alkaloid, fagarine, raised the fibrillation threshold during faradization of the ventricles and that it may prevent the fibrillation which follows ligation of the coronary arteries . . . . The intravenous injection of fagarine in dogs with an auricular flutter or fibrillation caused by aconitine abolishes these arrhythmias within one minute and leads to the reappearance of sinus rhythm."

MADDOCK, W. O.; RANKIN, V. M., AND YOUMANS, W. B.: Prevention of the anticurare action of epinephrine by dibenamine. Proc. Soc. Exper. Biol. & Med. **67**:151-153, Feb. 1948.

"Epinephrine is known to exert an anti-curare action at the skeletal neuromuscular junction. The mechanism of this action is unknown. It does not appear to be related to any influence on adrenergic neuro-effector systems . . . . The effects of Dibenamine [N, N-dibenzyl-beta-chloroethylamine] on the anti-curare actions of epinephrine and of Kcl have been studied in 7 dogs anesthetized with sodium pentobarbital or with morphine and ether. Dibenamine, in doses of 25-45 mg per kg, prevents the anti-curare action of epinephrine but does not prevent the anti-curare action of potassium chloride."

TOTH, LOUIS A.: Observations on ureteral peristalsis in unoperated dogs. Proc. Soc. Exper. Biol. & Med. **67**:70-77, Jan. 1948.

"Observations of ureteral peristalsis can be made on unoperated and unanesthetized dogs and conclusions drawn as to the activity of the ureters. Although the series is small, results suggest that nembutal inhibits ureteral peristaltic activity. The mechanism of this inhibition may be through the influence of the anesthetic directly on the ureter; or the anesthetic may affect the urine production and thus the volume of urine passing down the ureter, since variations in urine volume will affect peristalsis of the ureters."

SWANK, ROY L., AND FOLEY, JOSEPH M.: Respiratory, electroencephalographic, and blood gas changes in progressive barbiturate narcosis in dogs. J. Pharmacol. & Exper. Therap. **92**:381-396, April 1948.

"Unconsciousness as a result of an overdose of a barbiturate drug is becoming a familiar problem of the clinician . . . . Since the usual criteria for judging the depth of barbiturate narcosis clinically are frequently unreliable, further investigations of the physiologic changes which occur during narcosis are indicated . . . . During progressive sodium amytal narcosis in dogs observations were made on the electroencephalogram, respirations, blood gases, and reflex activity. Consistent correlations were observed, which indicated the relative depth of narcosis with a considerable degree of accuracy. The simultaneous occurrence of changes in the encephalogram and respiratory response to 10% $CO_2$ was particularly striking. Evidence is presented which suggests that the maintenance of a normal oxygen tension in the arterial blood lessens the depression of neuronal activity by sodium amytal . . . . "

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SHIDEMAN, F. E., AND HOHNSON, H. T.: Acute vascular tolerance to morphine, isonipecaine (demerol), and methadon (amidone) in the dog. J. Pharmacol. & Exper. Therap. **92**:414-420, April 1948.

"In the anesthetized dog intravenous administration of morphine, Demerol or Amidone results in an acute fall in blood pressure with gradual recovery occurring over a variable period of time. Repeated injection of morphine (2 or 4 mg. per kg.) results in complete vascular tolerance. Only partial acute tolerance develops to Demerol (5 mg. per kg.) administered similarly. The acute drop in blood pressure and rapid recovery, without the succeeding prolonged period of hypotension occurring after two doses of Amidone demonstrates the development of tolerance to the prolonged depressor effect of this drug. Tolerance to morphine confers only partial tolerance to Demerol and no tolerance to the acute hypotensive effect of Amidone. Repeated injection of Demerol produces no tolerance to morphine, no tolerance to the acute fall in blood pressure produced by Amidone, but tolerance to the prolonged period of hypotension occurring after a single dose of this latter drug. Repeated administration of Amidone results in no cross tolerance to morphine or Demerol. Anesthesia interferes with the compensatory mechanisms involved in the development of acute tolerance."

BENNETT, LESLIE L., AND FISHER, CARL W.: Effects of ether on the myocardium of the dog. J. Pharmacol. & Exper. Therap. **93**:482-485, Aug. 1948.

"Diethyl ether causes dilatation of the heart in experimental animals by direct action on the heart muscle and at concentrations within the normal anesthetic range. This commonly has been neglected or over-shadowed by discussions of disturbances in rhythm, though earlier workers demonstrated conclusively that such dilatation occurs . . . .

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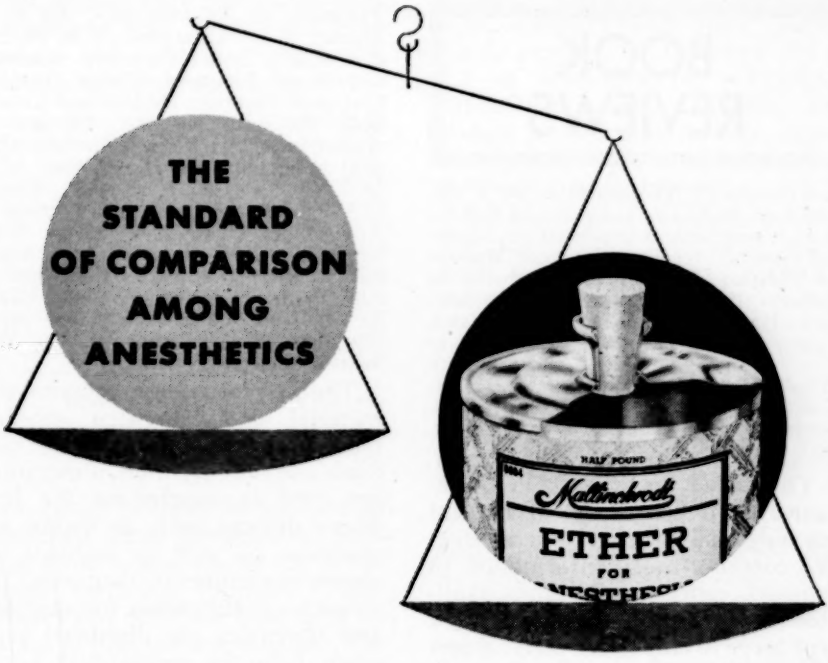
"2. Beginning with blood levels corresponding to second plane anesthesia and at all greater concentrations the dynamic changes produced are those of a failing heart."

WANG, S. C., AND NIMS, L. F.: Effect of various anesthetics and decerebration on the $CO_2$ stimulating action on respiration in cats. J. Pharmacol. & Exper. Therap. **92**:187-195, Feb. 1948.

"It is well known that most nonvolatile general anesthetics in dosages sufficiently large to produce surgical anesthesia depress respiration and respiratory reflexes. There have been, however, no data available to estimate quantitatively the degree of depression. The difficulty has been that there is no single, yet reliable means of recording the respiration quantitatively in unanesthetized animals. Recently, Hemingway . . . has developed a method, which enables one to measure the pulmonary ventilation . . . . Thus it is possible to determine quantitatively the effect of different anesthetics and decerebration on the stimulating action of $CO_2$ on respiration . . . . It was found that the control ventilation and the sensitivity of the respiratory system to increased $CO_2$ are not appreciably altered by urethane (1 gm. per kg., I.P.) or by midbrain decerebration. On the other hand, nembutal (35 mg. per kg., I.P.) or choloralose (35 mg. per kg., I.V.) markedly depresses the control respiration as well as respiratory response to increased $CO_2$ content in the inspired air."

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# BOOK REVIEWS

A SYNOPSIS OF ANAESTHESIA. By J. Alfred Lee, M.R.C.S., L.R.C.P., M.M.S.A., D.A., Consultant Anaesthetist to Southend General Hospital; Southend Municipal Hospital, Rochford; Anaesthetist to Tilbury Hospital; Runwell Hospital; East Ham Memorial Hospital; Essex County Council. Assistant Anaesthetist to King George Hospital, Ilford. Late Whole-time Anaesthetic Specialist, E.M.S. Cloth. 254 pages, 42 illustrations. Baltimore: The Williams & Wilkins Co., 1947. $4.00.

This small book, which was designed as a "summary of current teaching and practice" in anesthesia, contains much information in compact, concise, and readily available form. Outline forms and block type serve to emphasize each subject within each chapter. A thorough index is included.

PHYSIOLOGY AND ANATOMY. By Esther M. Greisheimer, Ph.D., M.D., Professor of Physiology, Temple University School of Medicine, Philadelphia; formerly Professor of Physiology, Woman's Medical College of Pennsylvania, Philadelphia; formerly Associate Professor of Physiology, the University of Minnesota, Minneapolis. ed. 5. Cloth. 841 pages, 478 illustrations. Philadelphia: J. B. Lippincott Co., 1945.

This excellent textbook cannot be recalled to nurse anesthetists too often. During the course in anesthesia and after graduation, anesthetists will have many occasions to refer to its contents.

The material is arranged by systems with the presentation of the anatomy first, followed by a chapter on the physiology of that system. The text is liberally illustrated. The illustrations, tables, list of references, glossary, and index increase the value of the book for study and reference.

TEXTBOOK OF ANAESTHETICS. By R. J. Minnitt, M.D. (Liverpool), D.A. (R.C.P. & S. Eng.), Senior Honorary Anaesthetist, Royal Liverpool United Hospital, Liverpool Maternity Hospital and Kirkenhead Maternity Hospital; Director of Anaesthetics, David Lewis Northern Hospital Liverpool; and John Gillies, M.C., M.B., Ch. B. (Edin.), F.R.C.S. (Edin.), D.A. (Eng.), J. Y. Simpson Lecturer in Anaesthetics, The University of Edinburgh; Director, Department of Anaesthetics, Royal Infirmary; Consultant in Anaesthetics, Department of Health for Scotland. ed. 7. Cloth. 568 pages, 229 illustrations. Baltimore: The Williams & Wilkins Co., 1948.

The present edition contains new material and rewritten chapters from the sixth edition. Two hundred and twenty-nine illustrations are used to supplement the text. Many devices such as masks and machines as well as technics are shown in pictures or diagrams. The subjects of anesthesia for dentistry and obstetrics are discussed separately from the general text. Chapters on curare, oxygen therapy, abnormal incidents, sequelae, and legal aspects are examples of the thorough coverage of the subject of anesthesia which the authors have presented. One fourth of the volume is devoted to the subject of regional anesthesia. Some phases of the presentation do not necessarily apply in the United States but there is much valuable information presented in a clear and concise manner. The volume is well indexed.

ANESTHESIA IN GENERAL PRACTICE. By Stuart C. Cullen, M.D., Head of Division of Anesthesiology, Department of Surgery, State University of Iowa Hospitals; Associate Professor of Surgery (Anesthesiology), State University of Iowa College of Medicine. ed. 2. Cloth. 264 pages, illustrated. Chicago: The Year Book Publishers, Inc., 1948.

This edition varies but little from the earlier edition which appeared two years ago. Changes in technics and drugs which have occurred

in the interim have been included in the present text. Thirty-six illustrations and cartoons, four tables, and an index supplement the text.

RECENT ADVANCES IN ANAESTHESIA AND ANALGESIA. By C. Langton Hewer, M.B., B.S. (Lond.), M.R.C.P. (Lond.) D.A. (Eng.), Senior Anaesthetist, St. Bartholomew's Hospital, St. Andrew's Hospital, Dollis Hill & the Hospital for Tropical Diseases; Consulting Anaesthetist, the Luton & Dunstable Hospital, Mid-Herts, West-Herts & Harpenden Hospitals; Member of the Board of Faculty of Anaesthetists. ed. 6. Cloth. 380 pages, 149 illustrations. Philadelphia: The Blakiston Co., 1948.

This book is one of a series entitled "Recent Advances." Although it is only four years since the publication of the fifth edition of this book, many changes in the field of anesthesia have necessitated additions to or remissions of the information on many subjects. These changes and additions have been included in the present edition. Numerous references at the end of each chapter and an index add to the value of the book as a handy reference.

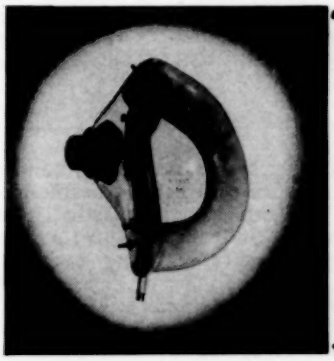
ELEMENTARY ANESTHESIA. By W. N. Kemp, M.D.C.M., Consultant Anesthetist, Children's Hospital, Vancouver, B.C. Cloth. 289 pages, 100 illustrations. Baltimore: Williams & Wilkins Co., 1948. $5.00.

By careful concentration, selection, and quotation, the author has succeeded in placing an amazing amount of information into comparatively few pages. Each chapter is followed by a list of bibliographic references. Equipment and technics are shown in the illustrations, many of which are reprinted from other textbooks on anesthesia.

In addition to chapters with the more commonly used headings, such as history, signs of anesthesia, and physiologic considerations, the author has included several subjects less often emphasized. Among these are chapters on "Anesthesia for War or Industrial Casualties," "Anesthesia Adapted to the Patients Handicapped," and "Status Lymphaticus." Indexed.

ENDOTRACHEAL ANAESTHESIA. By Noel A. Gillespie, D.M., B.ch., M.A. (Oxon.); M.D. (Wis.); D.A. (R.C.S. Eng.), Associate Professor of Anesthesia in the University of Wisconsin. ed. 2. Cloth. 237 pages, 56 illustrations, 1 color plate. Madison, Wis.: The University of Wisconsin Press, 1948. $4.50.

This edition is an enlarged and revised version of the original. The purpose of the book is to collect the facts about this special method of anesthesia in one volume. The author has emphasized the practical rather than the theoretical value of the intratracheal technic.



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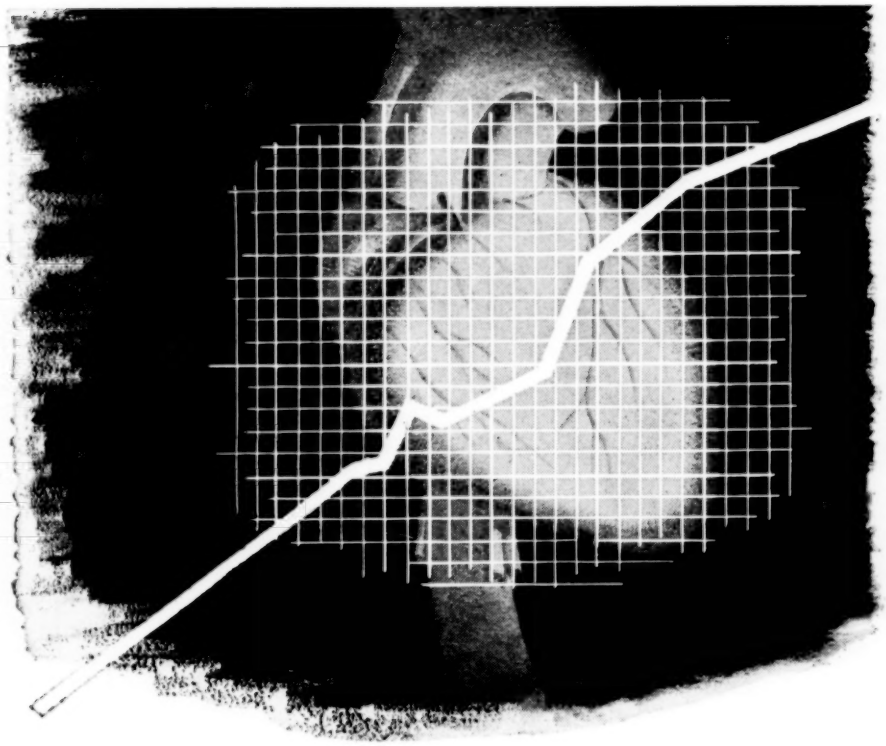

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